Appendix A

Surface Water and Aquatic Species Reference Tables

This page intentionally left blank

Table A-1 Surface Waters' Water Quality Classifications and Impairments Within Analysis Area

Lease Zone	Stream Name	Subwatershed Name	HUC-12	Lease Serial Number	Perennial (miles)	Intermittent (miles)	Ephemeral (miles)	Water Quality Classification	Impairment or Monitoring
1	Alkali Creek	Alkali Creek-Colorado River	140100051403	COC 066728	--	1.34	--	ALC2;Rp;WS;A	na
				COC 066729	--	0.75	--	ALC2;Rp;WS;A	na
				COC 066730	--	0.77	--	ALC2;Rp;WS;A	na
				COC 066732	--	0.59	--	ALC2;Rp;WS;A	na
	Horsethief Creek	Horsethief Creek-Colorado River	140100051404	COC 066732	--	1.56	--	ALC2;Rp;WS;A	na
	Little Alkali Creek	Alkali Creek-Colorado River	140100051403	COC 059630	--	0.75	--	ALC2;Rp;WS;A	na
				COC 066727	--	0.05	--	ALC2;Rp;WS;A	na
				COC 066728	--	0.58	--	ALC2;Rp;WS;A	na
	Little Horsethief Creek	Horseshoe Canyon-Colorado River	140100051406	COC 066926	--	1.48	--	UP;ALW2;Rp;A	na
	Unnamed	Alkali Creek-Colorado River	140100051403	COC 058677	--	3.24	5.36	ALC2;Rp;WS;A	na
				COC 059630	--	3.38	3.83	ALC2;Rp;WS;A	na
				COC 066727	--	2.21	3.04	ALC2;Rp;WS;A	na
				COC 066728	--	7.75	7.16	ALC2;Rp;WS;A	na
				COC 066729	--	2.31	2.15	ALC2;Rp;WS;A	na
				COC 066730	--	7.36	6.95	ALC2;Rp;WS;A	na
				COC 066731	--	3.55	1.70	ALC2;Rp;WS;A	na
				COC 066732	--	1.37	1.44	ALC2;Rp;WS;A	na
		Big Wash-Plateau Creek	140100051310	COC 066926	--	3.65	3.11	ALC1;Re;WS;A	na
		Horseshoe Canyon-Colorado River	140100051406	COC 066733	--	0.56	0.55	UP;ALW2;Rp;WS;A	na
				COC 066926	--	2.72	4.79	UP;ALW2;Rp;WS;A	na
		Horsethief Creek-Colorado River	140100051404	COC 066729	--	0.47	1.07	ALC2;Rp;WS;A	na
				COC 066732	--	7.95	6.92	ALC2;Rp;WS;A	na
				COC 066733	--	11.19	7.56	ALC2;Rp;WS;A	na

Table A-1 Surface Waters' Water Quality Classifications and Impairments Within Analysis Area

Lease Zone	Stream Name	Subwatershed Name	HUC-12	Lease Serial Number	Perennial (miles)	Intermittent (miles)	Ephemeral (miles)	Water Quality Classification	Impairment or Monitoring
				COC 066926	--	2.41	1.91	ALC2;Rp;WS;A	na
		Wallace Creek	140100051401	COC 066731	--	0.79	0.08	ALC2;Rp;WS;A	na
Zone 1 Total					**--**	**68.78**	**57.64**	**nd**	**na**
2	Alkali Creek	Alkali Creek	140100050303	COC 066723	--	0.89	--	ALC1;Rp;WS;A	na
				COC 066724	--	1.43	--	ALC1;Rp;WS;A	na
	Beaver Creek	Beaver Creek-Colorado River	140100050701	COC 066920	0.62	--	--	ALC1;Re;WS;A	na
	Cache Creek	Cache Creek-Colorado River	140100050702	COC 067544	0.57	--	--	ALC1;Re;WS;A	na
				COC 070014	1.26	--	--	ALC1;Re;WS;A	na
				COC 070015	0.38	--	--	ALC1;Re;WS;A	na
	Cottonwood Creek	Cache Creek-Colorado River	140100050702	COC 067544	0.60	0.32	--	ALC2;Rn;WS;A	na
	Dry Creek	Dry Creek-Colorado River	140100050604	COC 061121	--	0.95	--	ALC2;Rn;A	na
				COC 075070	--	0.07	--	ALC2;Rn;A	na
	Middle Mamm Creek	Middle Mamm Creek	140100050402	COC 067147	1.17	--	--	ALC2;Rn;WS;A	Impaired - Se
	Middleton Creek	Middleton Creek	140100051104	COC 070013	--	0.47	--	ALC1;Re;WS;A	na
	Owens Creek	Owens Creek	140100051101	COC 066917	0.03	--	--	ALC1;Re;WS;A	na
	Porcupine Creek	Beaver Creek-Colorado River	140100050701	COC 070014	--	0.18	--	ALC2;Rn;WS;A	na
	Reno Creek	Upper West Divide Creek	140100050302	COC 066916	--	1.44	--	ALC1;Rp;WS;A	na
				COC 066917	--	0.57	--	ALC1;Rp;WS;A	na
	Salt Creek	Middle West Divide Creek	140100050304	COC 066918	--	0.22	--	ALC1;Rp;WS;A	na
	Spruce Creek	Beaver Creek-Colorado River	140100050701	COC 070015	--	1.06	--	ALC2;Rn;WS;A	na
	West Divide Creek	Upper West Divide Creek	140100050302	COC 066915	0.44	--	--	ALC1;Rp;WS;A	na
				COC 066916	0.12	--	--	ALC1;Rp;WS;A	na
	West Mamm Creek	Dry Creek-Colorado River	140100050604	COC 061121	0.00	--	--	ALC2;Rn;WS;A	Impaired - Se

Table A-1 Surface Waters' Water Quality Classifications and Impairments Within Analysis Area

Lease Zone	Stream Name	Subwatershed Name	HUC-12	Lease Serial Number	Perennial (miles)	Intermittent (miles)	Ephemeral (miles)	Water Quality Classification	Impairment or Monitoring
		West Mamm Creek	140100050401	COC 061121	1.00	--	--	ALC2;Rn;WS;A	Impaired - Se
				COC 067150	0.76	--	--	ALC2;Rn;WS;A	Impaired - Se
	West Willow Creek	Headwaters West Divide Creek	140100050301	COC 066917	--	0.61	--	ALC1;Rp;WS;A	na
	Unnamed	Alkali Creek	140100050303	COC 066723	--	4.72	6.72	ALC1;Rp;WS;A	na
				COC 066724	--	4.41	3.59	ALC1;Rp;WS;A	na
				COC 066918	--	6.56	6.83	ALC1;Rp;WS;A	na
				COC 070361	--	1.01	2.42	ALC1;Rp;WS;A	na
				COC 072157	--	0.97	1.13	ALC1;Rp;WS;A	na
		Beaver Creek-Colorado River	140100050701	COC 066920	--	0.97	0.20	nd	na
				COC 067542	--	1.92	0.19	nd	na
				COC 070014	--	0.56	0.29	nd	na
				COC 070015	--	0.47	0.90	nd	na
		Cache Creek-Colorado River	140100050702	COC 067543	0.52	1.43	0.93	OW;ACL1;Re;WS;A	na
				COC 067544	--	2.27	0.40	nd	na
				COC 070014	--	2.67	1.27	nd	na
				COC 070015	--	3.57	0.47	nd	na
				COC 070016	--	0.27	--	nd	na
		Dry Creek-Colorado River	140100050604	COC 061121	--	1.39	1.88	nd	na
		East Mamm Creek	140100050403	COC 070013	--	2.70	2.20	nd	na
		Headwaters West Divide Creek	140100050301	COC 066917	--	--	0.58	nd	na
		Middle Mamm Creek	140100050402	COC 067147	--	1.54	0.80	nd	na
				COC 067150	--	--	0.09	nd	na
		Middle West Divide Creek	140100050304	COC 066723	--	1.70	1.51	ALC1;Rp;WS;A	na

Table A-1 Surface Waters' Water Quality Classifications and Impairments Within Analysis Area

Lease Zone	Stream Name	Subwatershed Name	HUC-12	Lease Serial Number	Perennial (miles)	Intermittent (miles)	Ephemeral (miles)	Water Quality Classification	Impairment or Monitoring
				COC 066918	--	2.66	4.07	nd	na
		Middleton Creek	140100051104	COC 070013	--	0.12	0.56	nd	na
				COC 072157	--	2.05	0.92	nd	na
		Owens Creek	140100051101	COC 066917	--	0.13	0.81	nd	na
		Upper West Divide Creek	140100050302	COC 066723	--	--	0.21	nd	na
				COC 066724	--	3.50	3.34	nd	na
				COC 066915	--	9.53	11.44	nd	na
				COC 066916	--	4.79	7.84	nd	na
				COC 066917	--	3.03	2.38	nd	na
		West Mamm Creek	140100050401	COC 061121	0.24	0.92	0.39	ALC2;Rn;WS;A	na
				COC 067147	--	0.97	--	nd	na
				COC 067150	--	1.89	0.39	nd	na
				COC 075070	--	1.95	0.15	nd	na
				COC 076123	--	0.51	0.13	nd	na
Zone 2 Total					**7.72**	**79.39**	**5.02**	**nd**	**na**
3	Beaver Creek	Fourmile Creek	140100041001	COC 066690	--	0.42	--	ALC1;Re;WS;A	na
				COC 066693	--	0.02	--	ALC1;Re;WS;A	na
				COC 066706	--	0.02	--	ALC1;Re;WS;A	na
				COC 066710	--	1.08	--	ALC1;Re;WS;A	na
	Beaver Dam Creek	Camp Creek-East Divide Creek	140100050305	COC 066707	0.41	--	--	ALC1;Rp;WS;A	na
				COC 066708	1.19	--	--	ALC1;Rp;WS;A	na
	Calf Creek	Thompson Creek	140100040708	COC 066908	--	1.89	--	OW;ALC1;Re;WS;A	na
				COC 066909	--	0.57	--	OW;ALC1;Re;WS;A	na
	Camp Creek	Camp Creek-East Divide Creek	140100050305	COC 066708	0.23	--	--	ALC1;Rp;WS;A	na
	Corral Creek	Thompson Creek	140100040708	COC 066711	--	0.35	--	OW;ALC1;Re;WS;A	na

Table A-1 Surface Waters' Water Quality Classifications and Impairments Within Analysis Area

Lease Zone	Stream Name	Subwatershed Name	HUC-12	Lease Serial Number	Perennial (miles)	Intermittent (miles)	Ephemeral (miles)	Water Quality Classification	Impairment or Monitoring
				COC 066712	--	1.48	--	OW;ALC1;Re;WS;A	na
	Dexter Creek	Thompson Creek	140100040708	COC 066700	--	0.16	--	ALC1;Re;WS;A	na
				COC 066701	--	1.42	--	ALC1;Re;WS;A	na
	Dry Rock Creek	Headwaters West Divide Creek	140100050301	COC 058840	--	0.48	--	ALC1;Rp;WS;A	na
				COC 066913	--	0.63	--	ALC1;Rp;WS;A	na
	East Divide Creek	Camp Creek-East Divide Creek	140100050305	COC 066708	2.01	--	--	ALC1;Rp;WS;A	na
	East Park Creek	Thompson Creek	140100040708	COC 066711	--	1.26	--	OW;ALC1;Re;WS;A	na
	East Willow Creek	Headwaters West Divide Creek	140100050301	COC 058835	1.51	--	--	ALC1;Rp;WS;A	na
				COC 058836	0.74	0.92	--	ALC1;Rp;WS;A	na
				COC 058839	0.77	--	--	ALC1;Rp;WS;A	na
	Edgerton Creek	Edgerton Creek-Crystal River	140100040709	COC 066693	--	0.90	--	ALC1;Re;WS;A	na
	Fourmile Creek	Fourmile Creek	140100041001	COC 066687	0.20	--	--	ALC1;Re;WS;A	na
				COC 066706	--	0.53	--	ALC1;Re;WS;A	na
				COC 066710	1.93	0.07	--	ALC1;Re;WS;A	na
	Freeman Creek	Fourmile Creek	140100041001	COC 066693	0.72	0.43	--	ALC1;Re;WS;A	na
	Ginright Creek	Camp Creek-East Divide Creek	140100050305	COC 066707	--	0.75	--	ALC1;Rp;WS;A	na
				COC 066708	--	1.51	--	ALC1;Rp;WS;A	na
	Lava Boulder Creek	Camp Creek-East Divide Creek	140100050305	COC 066708	0.49	--	--	ALC1;Rp;WS;A	na
	Little Beaver Creek	Headwaters West Divide Creek	140100050301	COC 058836	0.70	--	--	ALC1;Rp;WS;A	na
				COC 058837	0.40	--	--	ALC1;Rp;WS;A	na
				COC 058838	0.39	0.97	--	ALC1;Rp;WS;A	na
	Little Beaver Dam Creek	Camp Creek-East Divide Creek	140100050305	COC 066706	--	0.04	--	ALC1;Rp;WS;A	na
	Little Rock Creek	Headwaters West Divide Creek	140100050301	COC 058837	0.11	--	--	ALC1;Rp;WS;A	na
				COC 066709	--	0.14	--	ALC1;Rp;WS;A	na
	Middle Thompson Creek	Thompson Creek	140100040708	COC 066696	1.62	--	--	ALC1;Re;WS;A	na

Table A-1 Surface Waters' Water Quality Classifications and Impairments Within Analysis Area

Lease Zone	Stream Name	Subwatershed Name	HUC-12	Lease Serial Number	Perennial (miles)	Intermittent (miles)	Ephemeral (miles)	Water Quality Classification	Impairment or Monitoring
				COC 066697	1.24	--	--	ALC1;Re;WS;A	na
	Middle Willow Creek	Headwaters West Divide Creek	140100050301	COC 058835	--	0.67	--	ALC1;Rp;WS;A	na
				COC 058839	--	0.02	--	ALC1;Rp;WS;A	na
	North Thompson Creek	Thompson Creek	140100040708	COC 066691	0.51	--	--	OW;ALC1;Re;WS;A	na
				COC 066694	0.04	--	--	OW;ALC1;Re;WS;A	na
				COC 066712	0.38	--	--	OW;ALC1;Re;WS;A	na
				COC 066909	0.75	--	--	OW;ALC1;Re;WS;A	na
	Park Creek	Thompson Creek	140100040708	COC 066707	0.45	--	--	OW;ALC1;Re;WS;A	na
				COC 066711	0.87	--	--	OW;ALC1;Re;WS;A	na
	Porcupine Creek	Coal Creek	140100040704	COC 066702	1.48	--	--	ALC1;Re;WS;A	na
	Sand Creek	Thompson Creek	140100040708	COC 066693	--	0.17	--	OW;ALC1;Re;WS;A	na
				COC 066909	--	1.24	--	OW;ALC1;Re;WS;A	na
	South Branch Middle Thompson Creek	Thompson Creek	140100040708	COC 066695	0.04	--	--	ALC1;Re;WS;A	na
				COC 066698	--	1.04	--	ALC1;Re;WS;A	na
				COC 066701	1.66	0.55	--	ALC1;Re;WS;A	na
	South Thompson Creek	Thompson Creek	140100040708	COC 066699	--	0.27	--	ALC1;Re;WS;A	na
	West Divide Creek	Headwaters West Divide Creek	140100050301	COC 058837	3.18	--	--	ALC1;Rp;WS;A	na
				COC 058838	0.63	--	--	ALC1;Rp;WS;A	na
				COC 058839	1.35	--	--	ALC1;Rp;WS;A	na
		Upper West Divide Creek	140100050302	COC 058839	0.90	--	--	ALC1;Rp;WS;A	na
	West Willow Creek	Headwaters West Divide Creek	140100050301	COC 058839	--	0.56	--	ALC1;Rp;WS;A	na
	Willow Creek	Camp Creek-East Divide Creek	140100050305	COC 066708	--	1.32	--	ALC1;Rp;WS;A	na
		Headwaters West Divide Creek	140100050301	COC 058839	0.72	0.72	--	ALC1;Rp;WS;A	na
	Wolf Creek	Thompson Creek	140100040708	COC 066712	--	0.22	--	OW;ALC1;Re;WS;A	na
	Yank Creek	Thompson Creek	140100040708	COC 066693	--	0.70	--	OW;ALC1;Re;WS;A	na

Table A-1 Surface Waters' Water Quality Classifications and Impairments Within Analysis Area

Lease Zone	Stream Name	Subwatershed Name	HUC-12	Lease Serial Number	Perennial (miles)	Intermittent (miles)	Ephemeral (miles)	Water Quality Classification	Impairment or Monitoring
				COC 066908	1.18	0.45	--	OW;ALC1;Re;WS;A	na
				COC 066909	0.22	--	--	OW;ALC1;Re;WS;A	na
	Unnamed	Camp Creek-East Divide Creek	140100050305	COC 066706	--	3.44	1.39	nd	na
				COC 066707	--	1.46	1.49	nd	na
				COC 066708	--	2.34	1.93	nd	na
				COC 066709	--	0.21	0.65	nd	na
				COC 066710	1.46	2.30	1.62	ALC1;Rp;WS;A	na
		Clear Fork East Muddy Creek	140200040202	COC 058838	--	--	0.10	nd	na
		Coal Creek	140100040704	COC 066700	--	0.46	1.61	ALC1;Re;WS;A	na
				COC 066702	--	3.70	3.41	nd	na
		Edgerton Creek-Crystal River	140100040709	COC 066693	--	1.88	3.16	nd	na
				COC 066909	--	--	0.00	nd	na
		Fourmile Creek	140100041001	COC 066687	--	1.88	0.80	nd	na
				COC 066688	--	1.03	1.54	nd	na
				COC 066689	--	0.01	0.01	nd	na
				COC 066690	--	1.11	0.83	nd	na
				COC 066693	--	0.30	1.33	nd	na
				COC 066706	--	4.88	3.79	nd	na
				COC 066710	0.09	6.71	4.11	ALC1;Re;WS;A	na
				COC 066711	--	0.79	0.11	nd	na
				COC 066908	--	0.07	--	nd	na
		Headwaters West Divide Creek	140100050301	COC 058835	--	5.60	5.98	nd	na
				COC 058836	--	3.14	3.54	nd	na
				COC 058837	2.52	5.24	4.24	ALC1;Rp;WS;A	na
				COC 058838	--	2.75	2.88	nd	na

Table A-1 Surface Waters' Water Quality Classifications and Impairments Within Analysis Area

Lease Zone	Stream Name	Subwatershed Name	HUC-12	Lease Serial Number	Perennial (miles)	Intermittent (miles)	Ephemeral (miles)	Water Quality Classification	Impairment or Monitoring
				COC 058839	--	1.91	2.35	nd	na
				COC 058840	1.03	1.61	1.21	ALC1;Rp;WS;A	na
				COC 058841	1.25	3.53	2.20	ALC1;Rp;WS;A	na
				COC 066709	--	0.34	0.19	nd	na
				COC 066913	0.18	4.48	3.64	ALC1;Rp;WS;A	na
		Thompson Creek	140100040708	COC 066691	--	0.39	1.42	nd	na
				COC 066692	--	5.98	2.38	nd	na
				COC 066693	--	2.25	3.09	nd	na
				COC 066694	--	0.02	1.11	nd	na
				COC 066695	--	3.26	1.45	nd	na
				COC 066696	--	2.04	0.96	nd	na
				COC 066697	--	4.48	2.67	nd	na
				COC 066698	--	4.74	4.57	nd	na
				COC 066699	--	0.24	0.25	nd	na
				COC 066700	--	2.33	1.73	nd	na
				COC 066701	--	5.46	3.70	nd	na
				COC 066702	--	1.63	1.00	nd	na
				COC 066707	--	--	0.18	nd	na
				COC 066708	--	--	0.14	nd	na
				COC 066709	--	0.31	0.36	nd	na
				COC 066711	--	0.68	1.90	nd	na
				COC 066712	--	0.59	1.28	nd	na
				COC 066908	--	4.70	6.74	nd	na
				COC 066909	--	3.72	7.37	nd	na
				COC 066913	--	0.48	0.26	nd	na

Table A-1 Surface Waters' Water Quality Classifications and Impairments Within Analysis Area

Lease Zone	Stream Name	Subwatershed Name	HUC-12	Lease Serial Number	Perennial (miles)	Intermittent (miles)	Ephemeral (miles)	Water Quality Classification	Impairment or Monitoring
		Upper West Divide Creek	140100050302	COC 058839	--	0.17	0.38	nd	na
Zone 3 Total					**35.55**	**128.57**	**97.04**	**nd**	**na**
4	Grade Creek	Headwaters Milk Creek	140500020101	COC 066948	--	0.66	--	ALC1;Rp;WS;A	na
	Martin Creek	Headwaters Milk Creek	140500020101	COC 066948	0.46	0.17	--	ALC1;Rp;WS;A	na
	Unnamed	Headwaters Milk Creek	140500020101	COC 066948	--	2.05	0.56	nd	na
		Upper Milk Creek	140500020102	COC 066948	--	2.74	0.74	nd	na
Zone 4 Total					**0.46**	**5.63**	**1.30**	**nd**	**na**
Outside Leases	Alkali Creek	Alkali Creek	140100050303	na	--	9.50	--	ALC2;Rp;WS;A	na
		Alkali Creek-Colorado River	140100051403	na	--	6.58	--	ALC2;Rp;WS;A	na
		Middle West Divide Creek	140100050304	na	--	0.00	--	ALC2;Rp;WS;A	na
	Baldy Creek	Clear Fork East Muddy Creek	140200040202	na	2.83	1.84	--	ALC1;Re;WS;A	na
	Basin Creek	Clear Fork East Muddy Creek	140200040202	na	1.46	0.95	--	ALC1;Re;WS;A	na
	Battlement Creek	Cache Creek-Colorado River	140100050702	na	8.43	0.74	--	OW;ACL1;Re;WS;A	na
	Bear Creek	Coal Creek	140100040704	na	2.10	0.95	--	ALC1;Re;WS;A	na
	Beaver Creek	Beaver Creek-Colorado River	140100050701	na	11.93	0.23	--	ALC1;Re;WS;A	na
		Fourmile Creek	140100041001	na	--	0.36	--	ALC1;Re;WS;A	na
	Big Wash	Big Wash-Plateau Creek	140100051310	na	--	7.53	--	ALC1;Re;WS;A	na
	Boxelder Creek	Wallace Creek	140100051401	na	--	1.78	--	ALC2;Rp;WS;A	na
	Braderich Creek	Coal Creek	140100040704	na	2.20	0.97	--	ALC1;Re;WS;A	na
	Brook Creek	Middle West Divide Creek	140100050304	na	--	5.02	--	ALC1;Rp;WS;A	na
	Buzzard Creek	Middleton Creek	140100051104	na	0.01	--	--	ALC1;Re;WS;A	na
	Cache Creek	Cache Creek-Colorado River	140100050702	na	7.51	0.42	--	ALC1;Re;WS;A	na
	Camp Creek	Camp Creek-East Divide Creek	140100050305	na	3.44	--	--	ALC1;Rp;WS;A	na
	Camp Foster Creek	Thompson Creek	140100040708	na	--	2.38	--	ALC1;Re;WS;A	na
	Cheney Creek	Middleton Creek	140100051104	na	4.75	0.75	--	ALC1;Re;WS;A	na

Table A-1 Surface Waters' Water Quality Classifications and Impairments Within Analysis Area

Lease Zone	Stream Name	Subwatershed Name	HUC-12	Lease Serial Number	Perennial (miles)	Intermittent (miles)	Ephemeral (miles)	Water Quality Classification	Impairment or Monitoring
	Clear Creek	Headwaters Milk Creek	140500020101	na	6.10	2.15	--	ALC1;Rp;WS;A	na
		Middle West Divide Creek	140100050304	na	--	7.24	--	ALC1;Rp;WS;A	na
	Clear Fork	Clear Fork East Muddy Creek	140200040202	na	8.85	0.26	--	ALC1;Re;WS;A	na
	Coal Creek	Clear Fork East Muddy Creek	140200040202	na	4.63	0.92	--	ALC1;Re;WS;A	na
		Coal Creek	140100040704	na	7.66	1.95	--	ALC1;Re;WS;A	na
	Colorado River	Alkali Creek-Colorado River	140100051403	na	1.80	--	--	ALW1;Re;WS;A	Monitored - Sed
		Beaver Creek-Colorado River	140100050701	na	6.82	--	--	ALW1;Re;WS;A	Monitored - Sed
		Cache Creek-Colorado River	140100050702	na	8.50	--	--	ALW1;Re;WS;A	Monitored - Sed
		Dry Creek-Colorado River	140100050604	na	6.99	--	--	ALC1;Re;WS;A	Monitored - Sed
		Horseshoe Canyon-Colorado River	140100051406	na	7.01	--	--	ALW1;Re;WS;A	Monitored - Sed
		Horsethief Creek-Colorado River	140100051404	na	6.21	--	--	ALW1;Re;WS;A	Monitored - Sed
	Corral Creek	Thompson Creek	140100040708	na	--	0.08	--	OW;ALC1;Re;WS;A	na
	Cottonwood Creek	Cache Creek-Colorado River	140100050702	na	5.23	0.09	--	ALC2;Rn;WS;A	na
	Crystal River	Edgerton Creek-Crystal River	140100040709	na	9.76	--	--	ALC1;Re;WS;A	na
	Deadhorse Creek	Clear Fork East Muddy Creek	140200040202	na	3.18	0.91	--	ALC1;Re;WS;A	na
	Dexter Creek	Thompson Creek	140100040708	na	--	0.91	--	ALC1;Re;WS;A	na
	Dry Creek	Dry Creek-Colorado River	140100050604	na	--	9.93	--	ALC2;Rn;A	na
	Dry Owens Creek	Owens Creek	140100051101	na	--	3.74	--	ALC1;Re;WS;A	na
	Dry Rock Creek	Headwaters West Divide Creek	140100050301	na	--	0.27	--	ALC1;Rp;WS;A	na
	Dutch Creek	Coal Creek	140100040704	na	3.27	0.83	--	ALC1;Re;WS;A	na

Table A-1 Surface Waters' Water Quality Classifications and Impairments Within Analysis Area

Lease Zone	Stream Name	Subwatershed Name	HUC-12	Lease Serial Number	Perennial (miles)	Intermittent (miles)	Ephemeral (miles)	Water Quality Classification	Impairment or Monitoring
	East Divide Creek	Camp Creek-East Divide Creek	140100050305	na	3.16	1.05	--	ALC1;Rp;WS;A	na
	East Mamm Creek	East Mamm Creek	140100050403	na	11.35	1.24	--	ALC2;Rn;WS;A	Impaired - Se
	East Muddy Creek	Clear Fork East Muddy Creek	140200040202	na	0.00	--	--	ALC1;Re;WS;A	na
	East Park Creek	Thompson Creek	140100040708	na	--	0.27	--	OW;ALC1;Re;WS;A	na
	East Willow Creek	Headwaters West Divide Creek	140100050301	na	0.11	0.29	--	ALC1;Rp;WS;A	na
	Edgerton Creek	Edgerton Creek-Crystal River	140100040709	na	1.33	6.07	--	ALC1;Re;WS;A	na
	Fourmile Creek	Fourmile Creek	140100041001	na	12.15	--	--	ALC1;Re;WS;A	na
		Outlet Roaring Fork River	140100041003	na	0.01	--	--	ALC1;Re;WS;A	na
	Freeman Creek	Fourmile Creek	140100041001	na	4.41	0.37	--	ALC1;Re;WS;A	na
	Gas Creek	Owens Creek	140100051101	na	--	1.65	--	ALC1;Re;WS;A	na
	Gennings Creek	Camp Creek-East Divide Creek	140100050305	na	--	1.28	--	ALC1;Rp;WS;A	na
	Gooseberry Creek	Clear Fork East Muddy Creek	140200040202	na	2.78	--	--	ALC1;Re;WS;A	na
	Grade Creek	Headwaters Milk Creek	140500020101	na	--	1.49	--	ALC1;Rp;WS;A	na
	Horsethief Creek	Horsethief Creek-Colorado River	140100051404	na	--	9.28	--	ALC2;Rp;WS;A	na
	Jones Creek	Clear Fork East Muddy Creek	140200040202	na	4.39	0.32	--	ALC1;Re;WS;A	na
	June Creek	Clear Fork East Muddy Creek	140200040202	na	2.26	0.94	--	ALC1;Re;WS;A	na
	Lava Boulder Creek	Camp Creek-East Divide Creek	140100050305	na	0.57	--	--	ALC1;Rp;WS;A	na
	Lava Creek	Cache Creek-Colorado River	140100050702	na	1.10	--	--	OW;ACL1;Re;WS;A	na
	Little Alkali Creek	Alkali Creek-Colorado River	140100051403	na	--	5.24	--	ALC2;Rp;WS;A	na
	Little Beaver Creek	Upper Milk Creek	140500020102	na	--	1.83	--	ALW1;Rp;WS;A	na
	Little Beaver Dam Creek	Camp Creek-East Divide Creek	140100050305	na	--	1.37	--	ALC1;Rp;WS;A	na
	Little Horsethief Creek	Horseshoe Canyon-Colorado River	140100051406	na	--	5.81	--	UP;ALW2;Rp;A	na
	Little Muddy Creek	Clear Fork East Muddy Creek	140200040202	na	0.01	--	--	ALC1;Re;WS;A	na

Table A-1 Surface Waters' Water Quality Classifications and Impairments Within Analysis Area

Lease Zone	Stream Name	Subwatershed Name	HUC-12	Lease Serial Number	Perennial (miles)	Intermittent (miles)	Ephemeral (miles)	Water Quality Classification	Impairment or Monitoring
	Little Rock Creek	Headwaters West Divide Creek	140100050301	na	2.59	0.94	--	ALC1;Rp;WS;A	na
	Little Wash	Big Wash-Plateau Creek	140100051310	na	--	3.92	--	ALC1;Re;WS;A	na
	Mamm Creek	Dry Creek-Colorado River	140100050604	na	0.02	--	--	ALC2;Rn;WS;A	Impaired - Se
	Martin Creek	Headwaters Milk Creek	140500020101	na	2.31	0.34	--	ALC1;Rp;WS;A	na
	Martin Creek Ditch	Upper Milk Creek	140500020102	na	--	0.16	--	ALW1;Rp;WS;A	na
	Middle Mamm Creek	Middle Mamm Creek	140100050402	na	10.35	0.71	--	ALC2;Rn;WS;A	Impaired - Se
	Middle Thompson Creek	Thompson Creek	140100040708	na	3.99	1.02	--	ALC1;Re;WS;A	Monitored - Fe
	Middle Willow Creek	Headwaters West Divide Creek	140100050301	na	--	0.90	--	ALC1;Rp;WS;A	na
	Middleton Creek	Middleton Creek	140100051104	na	4.37	2.87	--	ALC1;Re;WS;A	na
	Milk Creek	Headwaters Milk Creek	140500020101	na	12.81	1.34	--	ALC1;Rp;WS;A	na
		Upper Milk Creek	140500020102	na	9.27	--	--	ALW1;Rp;WS;A	na
	Mosquito Creek	Upper West Divide Creek	140100050302	na	3.45	--	--	ALC1;Rp;WS;A	na
	North Fork Cheney Creek	Middleton Creek	140100051104	na	0.51	1.01	--	ALC1;Re;WS;A	na
	North Fork Wallace Creek	Wallace Creek	140100051401	na	4.09	0.70	--	ALC2;Rp;WS;A	na
	North Thompson Creek	Thompson Creek	140100040708	na	10.58	1.10	--	OW;ALC1;Re;WS;A	na
	North Twin Creek	Clear Fork East Muddy Creek	140200040202	na	2.00	0.34	--	ALC1;Re;WS;A	na
	Owens Creek	Owens Creek	140100051101	na	7.18	2.30	--	ALC1;Re;WS;A	na
	Park Creek	Thompson Creek	140100040708	na	0.89	--	--	OW;ALC1;Re;WS;A	na
	Plateau Creek	Big Wash-Plateau Creek	140100051310	na	10.83	--	--	ALC1;Re;WS;A	na
	Pole Creek	Middle West Divide Creek	140100050304	na	--	1.91	--	ALC1;Re;WS;A	na
	Porcupine Creek	Beaver Creek-Colorado River	140100050701	na	6.74	1.47	--	ALC2;Rn;WS;A	na
		Coal Creek	140100040704	na	1.13	0.08	--	ALC1;Re;WS;A	na
	Potato Bill Creek	Edgerton Creek-Crystal River	140100040709	na	--	2.13	--	ALC1;Re;WS;A	na

Table A-1 Surface Waters' Water Quality Classifications and Impairments Within Analysis Area

Lease Zone	Stream Name	Subwatershed Name	HUC-12	Lease Serial Number	Perennial (miles)	Intermittent (miles)	Ephemeral (miles)	Water Quality Classification	Impairment or Monitoring
	Prince Creek	Edgerton Creek-Crystal River	140100040709	na	9.33	0.88	--	ALC1;Re;WS;A	na
	Reno Creek	Upper West Divide Creek	140100050302	na	--	1.16	--	ALC1;Rp;WS;A	na
	Rifle Creek	Beaver Creek-Colorado River	140100050701	na	0.06	--	--	ALC1;Re;WS;A	na
	Roaring Fork River	Outlet Roaring Fork River	140100041003	na	12.84	--	--	ALC1;Re;WS;A	na
	Rock Creek	Clear Fork East Muddy Creek	140200040202	na	1.45	1.66	--	ALC1;Re;WS;A	na
	Salt Creek	Middle West Divide Creek	140100050304	na	1.20	2.16	--	ALC1;Re;WS;A	na
	Sand Creek	Thompson Creek	140100040708	na	--	0.48	--	OW;ALC1;Re;WS;A	na
	Second Creek	Clear Fork East Muddy Creek	140200040202	na	2.36	0.85	--	ALC1;Re;WS;A	na
	Sheep Creek	Middleton Creek	140100051104	na	--	3.17	--	ALC1;Re;WS;A	na
	Snowslide Creek	Wallace Creek	140100051401	na	--	0.60	--	ALC2;Rp;WS;A	na
	South Branch Edgerton Creek	Edgerton Creek-Crystal River	140100040709	na	--	3.33	--	ALC1;Re;WS;A	na
	South Branch Middle Thompson Creek	Thompson Creek	140100040708	na	3.03	0.74	--	ALC1;Re;WS;A	na
	South Thompson Creek	Thompson Creek	140100040708	na	3.92	2.61	--	ALC1;Re;WS;A	na
	South Twin Creek	Clear Fork East Muddy Creek	140200040202	na	2.40	0.34	--	ALC1;Re;WS;A	na
	Spring Creek	Coal Creek	140100040704	na	1.21	0.71	--	ALC1;Re;WS;A	na
	Spruce Creek	Beaver Creek-Colorado River	140100050701	na	--	4.56	--	ALC2;Rn;WS;A	na
	Tepee Creek	Beaver Creek-Colorado River	140100050701	na	--	1.65	--	ALC1;Re;WS;A	na
	Thomas Creek	Edgerton Creek-Crystal River	140100040709	na	6.85	1.01	--	ALC1;Re;WS;A	na
	Thompson Creek	Edgerton Creek-Crystal River	140100040709	na	0.00	--	--	ALC1;Re;WS;A	Monitored - Fe
		Thompson Creek	140100040708	na	4.43	0.03	--	ALC1;Re;WS;A	Monitored - Fe
	Threemile Creek	Outlet Roaring Fork River	140100041003	na	6.48	0.65	--	ALC1;Re;WS;A	na
	Timber Creek	Headwaters Milk Creek	140500020101	na	--	2.59	--	ALC1;Rp;WS;A	na

Table A-1 Surface Waters' Water Quality Classifications and Impairments Within Analysis Area

Lease Zone	Stream Name	Subwatershed Name	HUC-12	Lease Serial Number	Perennial (miles)	Intermittent (miles)	Ephemeral (miles)	Water Quality Classification	Impairment or Monitoring
	Twin Creek	Clear Fork East Muddy Creek	140200040202	na	0.22	--	--	ALC1;Re;WS;A	na
	Uhl Creek	Middleton Creek	140100051104	na	--	4.38	--	ALC1;Re;WS;A	na
	Wallace Creek	Wallace Creek	140100051401	na	9.12	1.38	--	ALC2;Rp;WS;A	na
	West Divide Creek	Headwaters West Divide Creek	140100050301	na	1.48	0.71	--	ALC1;Rp;WS;A	na
		Middle West Divide Creek	140100050304	na	9.18	--	--	ALC1;Re;WS;A	na
		Upper West Divide Creek	140100050302	na	5.28	--	--	ALC1;Rp;WS;A	na
	West Mamm Creek	Middle Mamm Creek	140100050402	na	0.00	--	--	ALC2;Rn;WS;A	Impaired - Se
		West Mamm Creek	140100050401	na	9.28	0.29	--	ALC2;Rn;WS;A	Impaired - Se
	West Prong Alkali Creek	Alkali Creek	140100050303	na	--	1.68	--	ALC1;Rp;WS;A	na
	West Willow Creek	Headwaters West Divide Creek	140100050301	na	--	2.18	--	ALC1;Rp;WS;A	na
	Willow Creek	Camp Creek-East Divide Creek	140100050305	na	--	0.10	--	ALC1;Rp;WS;A	na
		Headwaters West Divide Creek	140100050301	na	0.32	5.44	--	ALC1;Rp;WS;A	na
	Wolf Creek	Thompson Creek	140100040708	na	--	2.02	--	OW;ALC1;Re;WS;A	na
	Yank Creek	Thompson Creek	140100040708	na	0.89	0.48	--	OW;ALC1;Re;WS;A	na
	Unnamed	Alkali Creek	140100050303	na	--	33.06	39.36	nd	na
		Alkali Creek-Colorado River	140100051403	na	--	49.46	19.95	nd	na
		Beaver Creek-Colorado River	140100050701	na	2.49	105.35	35.84	nd	na
		Big Wash-Plateau Creek	140100051310	na	--	98.36	14.08	nd	na
		Cache Creek-Colorado River	140100050702	na	15.00	139.91	27.20	nd	na
		Camp Creek-East Divide Creek	140100050305	na	1.58	18.13	13.10	ALC1;Rp;WS;A	na
		Clear Fork East Muddy Creek	140200040202	na	9.15	40.01	38.04	ALC1;Re;WS;A	na
		Coal Creek	140100040704	na	5.24	61.61	48.17	ALC1;Re;WS;A	na
		Dry Creek-Colorado River	140100050604	na	2.69	94.95	9.51	nd	na

Table A-1 Surface Waters' Water Quality Classifications and Impairments Within Analysis Area

Lease Zone	Stream Name	Subwatershed Name	HUC-12	Lease Serial Number	Perennial (miles)	Intermittent (miles)	Ephemeral (miles)	Water Quality Classification	Impairment or Monitoring
		East Mamm Creek	140100050403	na	--	37.45	41.14	nd	na
		Edgerton Creek-Crystal River	140100040709	na	4.51	114.94	91.18	ALC1;Re;WS;A	na
		Fourmile Creek	140100041001	na	--	38.35	36.63	nd	na
		Headwaters Milk Creek	140500020101	na	2.94	91.25	43.81	ALC1;Rp;WS;A	na
		Headwaters West Divide Creek	140100050301	na	1.98	26.92	21.58	ALC1;Rp;WS;A	na
		Horseshoe Canyon-Colorado River	140100051406	na	0.09	170.74	27.13	nd	na
		Horsethief Creek-Colorado River	140100051404	na	--	142.89	44.22	nd	na
		Middle Mamm Creek	140100050402	na	1.33	23.32	23.14	ALC2;Rn;WS;A	na
		Middle West Divide Creek	140100050304	na	--	40.30	41.22	nd	na
		Middleton Creek	140100051104	na	--	38.30	43.15	nd	na
		Outlet Roaring Fork River	140100041003	na	3.28	63.07	51.14	nd	na
		Owens Creek	140100051101	na	--	24.74	28.11	nd	na
		Thompson Creek	140100040708	na	1.48	92.69	67.16	ALC1;Re;WS;A	na
		Upper Milk Creek	140500020102	na	4.71	70.82	25.55	ALW1;Rp;WS;A	na
		Upper West Divide Creek	140100050302	na	--	37.67	26.54	nd	na
		Wallace Creek	140100051401	na	0.18	56.98	21.13	ALC2;Rp;WS;A	na
		West Mamm Creek	140100050401	na	1.10	34.82	13.61	nd	na
Outside Leases Total					**416.48**	**1,924.93**	**891.70**	**nd**	**na**
Grand Total					**460.21**	**2,207.30**	**1,112.69**	**nd**	**na**

na: Not Applicable.

nd: Not Determined; the sum of unnamed streams within each Subwatershed are reported, which may contain more than one classification.

Sources: CDPHE 2015b,c, 2012; NRCS et al. 2010; USGS 2011.

Table A-2 Perennial Streams in Lease Zone 1

HUC-12 Name	HUC-12 Number	Stream Name	Stream Miles	Game Fish	Special Status Species[1]
Within Lease Zone					
None		None	0.00	None	None
		Total	0.00	None	None
Outside Lease Zone					
Wallace Creek	140100051401	Unnamed	0.18	None	None
		North Fork Wallace Creek	4.08	Brook trout, Colorado River cutthroat trout	Colorado River cutthroat trout (Mixed Blue and Green Lineage)
		Wallace Creek	9.12	Brook trout, Colorado River cutthroat trout, rainbow trout	Colorado River cutthroat trout (Mixed Blue and Green Lineage)
Horseshoe Canyon-Colorado River	140100051406	Unnamed	0.09	None	None
		Colorado River	7.01	Brown trout	Bluehead sucker, flannelmouth sucker, roundtail chub
Alkali Creek--Colorado River	140100051403	Colorado River	1.79	None	Bluehead sucker, flannelmouth sucker, roundtail chub
Horsethief Creek--Colorado River	140100051404	Colorado River	6.21	None	Bluehead sucker, flannelmouth sucker, roundtail chub
Big Wash-Plateau Creek	140100051310	Plateau Creek	10.83	None	Bluehead sucker, flannelmouth sucker, roundtail chub
		Total	**39.30**		

[1] All Colorado River cutthroat trout are considered special status species. However, management priority is on conservation populations.

Note: Colorado River Cutthroat Trout Lineages = Blue (native to Green and Yampa watersheds and Green (native to Colorado River watershed (AMEC 2014).

Sources: BLM 2015c; CPW 2015.

Table A-3 Perennial Streams in Lease Zone 2

HUC-12 Name	HUC-12 Number	Stream Name	Stream Miles	Game Fish	Special Status Species[1]
Within Lease Zone					
Upper West Divide Creek	140100050302	West Divide Creek	0.56	Upper Portion: Brook trout, Colorado River cutthroat trout Lower Portion: None	Colorado River cutthroat trout (Green Lineage) (CP[2])
West Mamm Creek	140100050401	Unnamed	0.24	None	None
		West Mamm Creek	1.76	None	None
Middle Mamm Creek	140100050402	Middle Mamm Creek	1.17	None	None
Dry Creek-Colorado River	140100050604	West Mamm Creek	<0.01	None	None
Beaver Creek-Colorado River	140100050701	Beaver Creek	0.62	Colorado River cutthroat trout	Colorado River cutthroat trout (Green Lineage) (CP[2])
Cache Creek-Colorado River	140100050702	Unnamed	0.52	None	None
		Cache Creek	2.21	Colorado River cutthroat trout	Colorado River cutthroat trout (Green Lineage) (CP[2])
		Cottonwood Creek	0.60	None	None
Owens Creek	140100051101	Owens Creek	0.03	Brook trout, Colorado River cutthroat trout	Bluehead sucker, Colorado River cutthroat trout (Unknown Lineage)
		Total	**7.72**		
Outside Lease Zone					
Middle West Divide Creek	140100050304	Salt Creek	1.20	None	None
		West Divide Creek	9.18	Upper Portion: Colorado River cutthroat trout Lower Portion: None	Upper Portion: Colorado River cutthroat trout (Green Lineage) (CP[2]) Lower Portion: Bluehead sucker, flannelmouth sucker, roundtail chub
West Mamm Creek	140100050401	Unnamed	1.10	None	None
		West Mamm Creek	9.28	None	None

Table A-3 Perennial Streams in Lease Zone 2

HUC-12 Name	HUC-12 Number	Stream Name	Stream Miles	Game Fish	Special Status Species[1]
Middle Mamm Creek	140100050402	Unnamed	1.33	None	None
		Middle Mamm Creek	10.35	None	None
		West Mamm Creek	<0.01	None	None
East Mamm Creek	140100050403	East Mamm Creek	11.35	None	None
Dry Creek-Colorado River	140100050604	Unnamed	2.69	None	None
		Mamm Creek	0.02	Unknown	Unknown
		Colorado River	6.98	Bluegill[3], brook trout, brown trout, cutthroat trout, green sunfish[3], mountain whitefish, rainbow trout, smallmouth bass[3]	Bluehead sucker, flannelmouth sucker, roundtail chub
Beaver Creek-Colorado River	140100050701	Unnamed	2.49	None	None
		Beaver Creek	11.93	Brown trout, Colorado River cutthroat trout, rainbow trout	Colorado River cutthroat trout (Green Lineage) (CP[2])
		Porcupine Creek	6.74	Unknown	Unknown
		Rifle Creek	0.06	Unknown	Unknown
		Colorado River	6.82	Black crappie[3], bluegill[3], brook trout, brown trout, cutthroat trout, green sunfish[3], mountain whitefish, smallmouth bass[3], walleye[3]	Bluehead sucker, flannelmouth sucker, roundtail chub
Cache Creek-Colorado River	140100050702	Unnamed	14.99	None	None
		Battlement Creek	8.43	Colorado River cutthroat trout	Colorado River cutthroat trout (Blue Lineage) (CP[2])
		Cache Creek	7.51	Brook trout, Colorado River cutthroat trout	Colorado River cutthroat trout (Green Lineage) (CP[2])
		Cottonwood Creek	5.23	Unknown	Unknown
		Lava Creek	1.10	Unknown	Unknown

Table A-3 Perennial Streams in Lease Zone 2

HUC-12 Name	HUC-12 Number	Stream Name	Stream Miles	Game Fish	Special Status Species[1]
		Colorado River	8.50	Bluegill[3], brook trout, brown trout, cutthroat trout, green sunfish[3], mountain whitefish, rainbow trout, smallmouth bass[3]	Bluehead sucker, flannelmouth sucker, roundtail chub
Owens Creek	140100051101	Owens Creek	7.18	Brook trout, Colorado River cutthroat trout	Bluehead sucker, Colorado River cutthroat trout (Unknown Lineage), boreal toad
Middleton Creek	140100051104	Cheney Creek	4.75	Unknown	Unknown
		Middleton Creek	4.37	Unknown	Unknown
		North Fork Cheney Creek	0.51	Unknown	Unknown
		Total	**144.08**		

[1] All Colorado River cutthroat trout are considered special status species. However, management priority is on conservation populations.

[2] CP = Conservation Population.

[3] Incidental occurrence, not considered a fishery.

Note: Colorado River Cutthroat Trout Lineages = Blue (native to Green and Yampa watersheds and Green (native to Colorado River watershed (AMEC 2014).
Miles shown as 0.00 represent < 0.01 mile.

Sources: BLM 2015; CPW 2015c.

Table A-4 Perennial Streams in Lease Zone 3

HUC-12 Name	HUC-12 Number	Stream Name	Stream Miles	Game Fish	Special Status Species[1]
Within Lease Zone					
Coal Creek	140100040704	Porcupine Creek	1.48	Unknown	Unknown
Thompson Creek	140100040708	Middle Thompson Creek	2.86	Colorado River cutthroat trout	Colorado River cutthroat trout (Blue Lineage) (CP[2])
		North Thompson Creek	1.68	Brook trout, brown trout, Colorado River cutthroat trout	Colorado River cutthroat trout (Blue and Green Lineage)
		Park Creek	1.32	Brook trout, Colorado River cutthroat trout	Colorado River cutthroat trout (Green Lineage) (CP[2])
		South Branch Middle Thompson Creek	1.71	Unknown	Unknown
		Yank Creek	1.40	Unknown	Unknown
Fourmile Creek	140100041001	Unnamed	0.09	None	None
		Fourmile Creek	2.13	Brown trout, rainbow trout	None
		Freeman Creek	0.72	Unknown	Unknown
Headwaters West Divide Creek	140100050301	Unnamed	4.98	None	None
		East Willow Creek	3.03	Unknown	Unknown
		Little Beaver Creek	1.49	Unknown	Unknown
		Little Rock Creek	0.11	Colorado River cutthroat trout	Colorado River cutthroat trout (Green Lineage) (CP[2])
		West Divide Creek	5.15	Colorado River cutthroat trout, rainbow trout, cutthroat x rainbow trout hybrid	Colorado River cutthroat trout (Green Lineage) (CP[2]), bluehead sucker, flannelmouth sucker, roundtail chub
		Willow Creek	0.72	Unknown	Unknown
Upper West Divide Creek	140100050302	West Divide Creek	0.90	Colorado River cutthroat trout	Colorado River cutthroat trout (Green Lineage), bluehead sucker, flannelmouth sucker, roundtail chub

Table A-4 Perennial Streams in Lease Zone 3

HUC-12 Name	HUC-12 Number	Stream Name	Stream Miles	Game Fish	Special Status Species[1]
Camp Creek-East Divide Creek	140100050305	Unnamed	1.46	None	None
		East Divide Creek	2.01	Colorado River cutthroat trout, cutthroat x rainbow trout hybrid	Colorado River cutthroat trout (Blue Lineage), northern leopard frog
		Beaver Dam Creek	1.60	To be determined	To be determined
		Camp Creek	0.23	Colorado River cutthroat trout	Colorado River cutthroat trout (Blue Lineage((CP[2])
		Lava Boulder Creek	0.49	To be determined	To be determined
		Total	**35.55**		
Outside Lease Zone					
Coal Creek	140100040704	Unnamed	5.24	None	None
		Bear Creek	2.10	Unknown	Unknown
		Braderich Creek	2.20	Unknown	Unknown
		Coal Creek	7.66	Unknown	Unknown
		Dutch Creek	3.27	Unknown	Unknown
		Porcupine Creek	1.13	Unknown	Unknown
		Spring Creek	1.21	Unknown	Unknown
Thompson Creek	140100040708	Unnamed	1.48	None	None
		Middle Thompson Creek	3.99	Brown trout, Colorado River cutthroat trout	Colorado River cutthroat trout (Blue Lineage) (CP[2])
		North Thompson Creek	10.58	Brook trout, brown trout, Colorado River cutthroat trout, rainbow trout, cutthroat x rainbow trout hybrid	Colorado River cutthroat trout (Blue and Green Lineage)
		South Branch Middle Thompson Creek	3.03	Brook trout, brown trout, cutthroat trout	None
		South Thompson Creek	3.92	Brown trout	None

Table A-4 Perennial Streams in Lease Zone 3

HUC-12 Name	HUC-12 Number	Stream Name	Stream Miles	Game Fish	Special Status Species[1]
		Thompson Creek	4.43	Brown trout, Colorado River cutthroat trout, rainbow trout, cutthroat x rainbow trout hybrid	Colorado River cutthroat trout (Mostly Blue Lineage)
		Yank Creek	0.89	Unknown	Unknown
		Park Creek	0.89	Brook trout, Colorado River cutthroat trout	Colorado River cutthroat trout (Green Lineage) (CP[2])
Edgerton Creek-Crystal River	140100040709	Unnamed	4.50	None	None
		Edgerton Creek	1.33	Unknown	Unknown
		Prince Creek	9.33	To be determined	To be determined
		Thomas Creek	6.85	To be determined	To be determined
		Thompson Creek	<0.01	Brown trout, Colorado River cutthroat trout, rainbow trout	Colorado River cutthroat trout (Likely Blue Lineage)
		Crystal River	9.76	Brook trout, brown trout, Colorado River cutthroat trout, mountain whitefish, rainbow trout	Bluehead sucker, Colorado River cutthroat trout, flannelmouth sucker
Fourmile Creek	140100041001	Fourmile Creek	12.15	Brown trout, Colorado River cutthroat trout, rainbow trout	Colorado River cutthroat trout
		Freeman Creek	4.41	Unknown	Unknown
Outlet Roaring Fork River	140100041003	Unnamed	3.28	None	None
		Fourmile Creek	0.01	Brown trout, rainbow trout	None
		Threemile Creek	6.48	Brook trout, rainbow trout	None
		Roaring Fork River	12.84	Brook trout, brown trout, Colorado River cutthroat trout, mountain whitefish, rainbow trout, cutthroat x rainbow trout hybrid	Bluehead sucker, Colorado River cutthroat trout, flannelmouth sucker
Headwaters West Divide Creek	140100050301	Unnamed	1.98	None	None
		East Willow Creek	0.11	Unknown	Unknown

Table A-4 Perennial Streams in Lease Zone 3

HUC-12 Name	HUC-12 Number	Stream Name	Stream Miles	Game Fish	Special Status Species[1]
		Little Rock Creek	2.59	Colorado River cutthroat trout	Colorado River cutthroat trout (Green Lineage)
		West Divide Creek	1.47	Colorado River cutthroat trout	Colorado River cutthroat trout (Green Lineage), bluehead sucker, flannelmouth sucker, roundtail chub
		Willow Creek	0.32	None	Bluehead sucker
Upper West Divide Creek	140100050302	Mosquito Creek	3.45	Unknown	Unknown
		West Divide Creek	5.28	Colorado River cutthroat trout, rainbow trout, cutthroat x rainbow trout hybrid	Bluehead sucker, Colorado River cutthroat trout (Green Lineage), flannelmouth sucker, roundtail chub
Camp Creek-East Divide Creek	140100050305	Unnamed	1.58	None	None
		East Divide Creek	3.16	Colorado River cutthroat trout, rainbow trout	Bluehead sucker, Colorado River cutthroat trout (Blue Lineage), northern leopard frog
		Camp Creek	3.44	Colorado River cutthroat trout	Colorado River cutthroat trout (Blue Lineage) (CP[2])
		Lava Boulder Creek	0.57	To be determined	To be determined
Clear Fork-East Muddy Creek	140200040202	Unnamed	9.15	None	None
		Clear Fork	8.85	Unknown	Unknown
		Baldy Creek	2.83	To be determined	To be determined
		Basin Creek	1.46	To be determined	To be determined
		Coal Creek	4.62	Unknown	Unknown
		Deadhorse Creek	3.18	Unknown	Unknown
		East Muddy Creek	<0.01	Unknown	Unknown
		Gooseberry Creek	2.78	Unknown	Unknown
		Jones Creek	4.39	Unknown	Unknown

Table A-4 Perennial Streams in Lease Zone 3

HUC-12 Name	HUC-12 Number	Stream Name	Stream Miles	Game Fish	Special Status Species[1]
		June Creek	2.26	None	Northern leopard frog
		Little Muddy Creek	0.01	Unknown	Unknown
		North Twin Creek	2.00	Brook trout, Colorado River cutthroat trout	Colorado River cutthroat torut
		Rock Creek	1.45	Brook trout, Colorado River cutthroat trout	Colorado River cutthroat torut
		Second Creek	2.36	Brook trout, Colorado River cutthroat trout	Colorado River cutthroat torut
		South Twin Creek	2.40	Brook trout, Colorado River cutthroat trout	Colorado River cutthroat torut
		Twin Creek	0.22	Unknown	Unknown
		Total	**194.87**		

[1] All Colorado River cutthroat trout are considered special status species. However, management priority is on conservation populations.

[2] CP = Conservation Population.

Note: Colorado River Cutthroat Trout Lineages = Blue (native to Green and Yampa watersheds and Green (native to Colorado River watershed (AMEC 2014).
Miles shown as 0.00 represent < 0.01 mile.

Sources: BLM 2015; CPW 2015.

Table A-5 Perennial Streams in Lease Zone 4

HUC-12 Name	HUC-12 Number	Stream Name	Stream Miles	Game Fish	Special Status Species[1]
Within Lease Zone					
Headwaters Milk Creek	140500020101	Martin Creek	0.46	Unknown	Unknown
		Total	0.46		
Outside Lease Zone					
Headwaters Milk Creek	140500020101	Unnamed	2.94	None	None
		Clear Creek	6.10	Unknown	Unknown
		Martin Creek	2.31	Unknown	Unknown
		Milk Creek	12.81	Colorado River cutthroat trout	Colorado River cutthroat trout (Blue Lineage) (CP[2])
Upper Milk Creek	140500020102	Unnamed	4.71	None	None
		Milk Creek	9.27	None	Bluehead sucker, Colorado River cutthroat trout (Blue Lineage) (CP[2]), flannelmouth sucker, roundtail chub
		Total	**38.14**		

[1] All Colorado River cutthroat trout are considered special status species. However, management priority is on conservation populations.

[2] CP = Conservation Population.

Note: Colorado River Cutthroat Trout Lineages = Blue (native to Green and Yampa watersheds and Green (native to Colorado River watershed (AMEC 2014).
Miles shown as 0.00 represent < 0.01 mile.

Sources: BLM 2015; CPW 2015.

This page intentionally left blank

Appendix B

Cumulative Impacts Scenario

This page intentionally left blank

Contents

Cumulative Impacts Scenario B-1

B.1 Cumulative Impact Analysis Areas B-1

B.2 Past and Present Actions B-4

B.2.1 Actions with Surface Disturbance, Water Use or Transportation Impacts B-4

B.2.2 Other USFS District or BLM Field Office Actions B-7

B.3 Reasonably Foreseeable Future Actions B-8

B.3.1 Actions with Surface Disturbance, Water Use or Transportation Impacts B-9

B.3.2 Other USFS District or BLM Field Office Actions B-18

B.3.3 County Actions B-22

List of Tables

Table B-1 Cumulative Impact Analysis Areas by Resource B-2

Table B-2 Past and Present Surface Disturbing Actions by CIAA B-5

Table B-3 Long Term Surface Disturbance from Oil and Gas Development by CIAA B-10

Table B-4 Projected Water Use from Oil and Gas Development B-11

Table B-5 Projected Transportation Requirements from Oil and Gas Development B-11

Table B-6 Long Term Surface Disturbance from Recently Approved or Pending APDs by CIAA B-16

Table B-7 Long Term Surface Disturbance from Non-Oil and Gas Development by CIAA B-17

Table B-8 Vegetation Treatments and Hazardous Fuels Reduction RFFAs by CIAA B-20

This page intentionally left blank

Cumulative Impacts Scenario

Cumulative impacts are those that would result when lease development (as outlined in Chapter 2.0) is combined with disturbances of past and present actions and other reasonably foreseeable future actions (RFFAs), regardless of what agency or private entity undertakes such actions. Cumulative impacts can result from individually minor, but collectively significant actions taking place over a period of time (40 Code of Federal Register [CFR] 1508.7). The following sections outline past and present actions and RFFAs with potential to cause cumulative impacts in combination with lease development. Relevant actions were identified through consideration of geographic location, type of activity, and type of resource impacts.

B.1 Cumulative Impact Analysis Areas

The geographic extent of cumulative impacts varies by resource. Impacts to some resources, such as cultural resources or soils, are restricted to the area within the leases. Other resources, such as wildlife and water resources, may be affected over a larger area; therefore, cumulative impacts are assessed beyond the leases. Twelve spatially distinct cumulative impact analysis areas (CIAAs) are identified in **Table B-1**. The CIAAs primarily comprise National Forest System lands (White River National Forest [WRNF] and Grand Mesa, Uncompahgre, and Gunnison National Forest [GMUGNF]) but also include BLM lands within the Colorado River Valley Field Office (CRVFO), Grand Junction FO (GJFO), and White River FOs (WRFO), as well as non-federal lands.

Table B-1 Cumulative Impact Analysis Areas by Resource

Resource	Cumulative Impact Analysis Area Description	Spatial Extent (acres)	Rationale for Use
Geology/Minerals/Paleontology, Soils, General Vegetation, Nongame and Small Game Terrestrial Wildlife, Special Status Species Terrestrial Wildlife, Land Use, Recreation, Visual Resources	65 existing leases (identified as "Lease Area in subsequent tables)	80,380	Primary impact from reasonably foreseeable future development would be due to surface disturbance on the leases.
Special Status Plants[1]	Lease area plus a 300-foot buffer around known populations within 65 existing leases	Varies depending on species	Buffer considers impacts to known plant species and surrounding area that may be disturbed.
Cultural Resources/Native American Traditional Values, Groundwater	Lease area plus a 2-mile buffer around 65 existing leases (identified as "Lease+2 miles" in subsequent tables)	332,040	Buffer considers impacts to the context of cultural resources and extent groundwater sources that may encountered within the leases.
Transportation, Hazardous Materials/ Human Health and Safety	Lease area plus the regional road network used to access leases	N/A	Addresses impacts to new and existing local access roads from project-related transportation.
Surface Water Quality and Quantity, Aquatics	HUC-12 watersheds crossed by leases (identified as "HUC-12" in subsequent tables)	606,006	Takes into account effects of activity on-lease and downstream.
Big Game	Big Game GMUs crossed by lease.	2,121,890	Puts habitat disturbance from future development into context of entire area used by big game.
Greater Sage-grouse	Preliminary Priority Habitat and Preliminary General Habitat polygons crossed by leases	14,155	Puts habitat disturbance from future development into context of entire sage-grouse habitat areas in vicinity.
Lynx	Lynx Analysis Units polygons crossed by leases	510,805	Puts habitat disturbance from future development into context of entire area used by lynx.
Livestock Grazing	Grazing allotments crossed by lease.	308,666	Puts disturbance from future development into context of entire allotment.

Table B-1 Cumulative Impact Analysis Areas by Resource

Resource	Cumulative Impact Analysis Area Description	Spatial Extent (acres)	Rationale for Use
Special Designations	Special Designations within leases (1 RNA and portions of roadless areas)	64,864	Future development outside existing leases would be limited by special designation management requirements. Impacts from future development therefore limited to special designations within existing leases.
Socioeconomics and Environmental Justice[2]	Mesa, Garfield, Pitkin, and Rio Blanco counties	N/A	Economics and populations of four-county area could be affected by future development.
Air Quality; Climate[3]	Northwest region of Colorado	N/A	Incorporates the analysis contained in the Colorado Air Resource Management Modeling Study (CARMMS).

[1] Acreage for Special Status Plant CIAA is not included in subsequent tables because the scale at which projects are identified is too coarse to differentiate between this CIAA and the lease CIAA.

[2] Acreage for Social and Economic Values/Environmental Justice CIAA, which comprises Garfield, Mesa, Pitkin, and Rio Blanco counties, are not included in this or subsequent tables because surface disturbance is not an impact indictor used for cumulative analysis of this resource.

[3] Acreages for an Air Resources CIAA are not included because the cumulative impact analysis for air resources considers the entire northwest region of Colorado and relates to the analysis contained in the CARMMS.

Source: GIS from WRNF.

B.2 Past and Present Actions

The primary past and present actions with surface disturbance affecting the resources analyzed in this EIS include mineral development; road development and other land development such as ROWs for pipelines, telephone lines or other developments. These types of actions are described in greater detail in Section B.2.1. Other past and present actions, such as farming, timber harvests, livestock grazing, and vegetation treatments also may affect resources considered in this EIS but do not have quantifiable surface disturbance. These are discussed qualitatively in Section B.2.2 as well as in applicable Affected Environment sections.

B.2.1 Actions with Surface Disturbance, Water Use or Transportation Impacts

Table B-2 presents total quantifiable surface disturbance by CIAA. Sections B2.1.1 through B2.1.3 provide additional information regarding the location and type of disturbance.

Table B-2 Past and Present Surface Disturbing Actions by CIAA

Past/Present Actions	Long-term Disturbance by CIAA (acres/ percent)							
	Lease Area	Lease+2 miles	HUC-12	Big Game	Sage-grouse	Lynx	Range	Special Desig.
Mineral Development[1]	38 / <1	590 / <1	2,658 /<1	4,262 /<1	22 /<1	693 /<1	92 /<1	3 /<1
Transportation Corridors[2]	91 / <1	249 / <1	1,460 /<1	3,282 /<1	28 /<1	669 /<1	390 /<1	1 /<1
Other Land Development	325 / <1	304 / <1	1108 /<1	1153 /<1	0 /<1	695 /<1	627 /<1	0 /<1
TOTAL	**454 / <1**	**612 / <1**	**5,226 /<1**	**8,697 /<1**	**50 /<1**	**2,057 /<1**	**1,109 /<1**	**4 /<1**

[1] Number of wells by CIAA: Lease Area-75; Lease+2 miles -1,180, HUC-12-5,315; Big Game-8,523; Sage-Grouse-43; Lynx-1,385; Range-183; Special Designations-5. Well count incudes all COGCC well categories except “permitted locations”. Long term surface disturbance assumptions: Wellpad size- 0.5 acres per well (see Chapter 2).

[2] Disturbance acreages for roads assume the following widths: Interstate: 72 feet (4 lanes); principal arterial: 60 feet (4 lanes); minor arterial: 60 feet (2 lanes); major collector: 30 feet (2 lanes); minor collector: 15 feet (2 lanes); local road: 22 feet (1 lane).

Source: BLM 2015a, 2014a, COGCC 2015, CDOT 2015, USDOT 2013.

B.2.1.1 Mineral Development

As discussed in Section 3.3, Geology and Minerals, there are numerous gas fields in and near the existing leases as well as other mineral commodities, including coal, oil shale, uranium, and aggregate. Most mines are located within the Interstate 70 corridor (north of the Zone 1, 2, and 3 leases and outside of most CIAAs; see Figure 3.3-8). There are no existing mines near the Zone 4 lease. The COGCC database was used to identify existing oil and gas development within the CIAAs. Long term surface disturbance from oil and gas has been calculated using the wellpad disturbance assumptions contained in Chapter 2.0, and is presented by CIAA in **Table B-2**. Recently approved and pending APDs within the CIAAs are discussed in Section B.3.1.2.

As discussed in Section 3.8, there are over 560,000 acre-feet and 5,400 cubic feet per second (cfs) that are assigned the use of “Industrial” within Garfield, Mesa and Pitkin counties, which would include oil and gas development. The COGCC database includes 22,540 existing wells within these three counties. Using the water use assumptions outlined in Chapter 2, past well development would have required the use 17,356 acre-feet of freshwater for drilling and 145,158 acre-feet of recycled water for well completion.

B.2.1.2 Transportation and Utility Corridors

The region is transected by or adjacent to two federal highways; three state highways; and numerous BLM, Forest Service, and county roads (see Section 3.10, Transportation). Road mileage was identified through CDOT road layers for each of the CIAAs. Surface disturbance was calculated using typical lane and shoulder widths for each Federal functional road classification (see USDOT 2013) and is presented in **Table B-2**.

B.2.1.3 Other Land Development

There are 162 communications sites on the WRNF (USFS 2014a) and the CRVFO administers over 20 communication sites each year (BLM 2015b). There are 5 communication/repeater sites within the Big Game CIAA; 3 sites within the Lynx CIAA, 2 sites within the HUC-12 and range CIAAs, portions of one site within the Lease Area CIAA, and no sites within the Special Designations or Sage-grouse CIAAs (BLM 2014a). Acreages of all identified communication sites are presented in **Table B-2.** There also are numerous existing power lines within each of the CIAAs; however, locations and disturbance acreages have not been quantified for the purposes of this analysis due to the scattered nature of the transmission lines and size of the CIAAs.

The BLM Legacy Rehost System (known as LR2000) was used to identify more recent BLM authorizations that would result in surface disturbance within any of the CIAAs. The LR2000 system reported 35 ROW authorizations between April 2014 and April 2015 in one or more CIAAs. These included ROWs for water facilities (225 acres), oil and gas pipelines (244 acres), as well as roads, salt disposal, telephone lines, communication sites and other authorizations. All actions are within the CIAAs for Lease Zones 1, 2, and 3; there were no recent actions identified within the CIAAs surrounding the Lease Zone 4. Acreages are summarized in **Table B-2**; however, it should be noted not all ROW disturbances result in long term surface disturbance (for example, pipeline disturbance is typically reclaimed). The LR2000 system also identified a number of ROW renewals, lease communitization agreements and land sales within the CIAAs. These are not included in **Table B-2** because there is no new surface disturbance associated with these authorizations. The USFS Schedules of Proposed Action (SOPA) and Notices of Proposed Action (NOPA) documents for the same time period did not identify any ROW development or other recently approved projects on NFS lands.

B.2.2 Other USFS District or BLM Field Office Actions

The following sections describe other types of past and present development within the CIAAs. These actions are not included in **Table B-2** because they do not necessarily result in surface disturbance; may not have adverse impacts on all resources; and in some cases may have a countervailing effect on cumulative impacts.

B.2.2.1 Livestock Grazing and Agriculture

Livestock grazing operations have been active within the WRNF for almost 100 years. The WRNF currently supports approximately 65 livestock grazing operations on 88 active allotments (USFS 2014a). The leases overlap a total of 19 allotments (308,522 acres). Grazing improvements within the CIAAs include fences, water tanks or ponds. Approximately 12 percent of the WRNF and 4 percent of the leases are within the grassland/forb vegetation community (USFS 2014a; also see Section 3.6, Vegetation). The CIAAs also may include lands that have been converted to agricultural uses; however, WRNF vegetation data does not specifically identify an agricultural land cover type within the WRNF.

B.2.2.2 Vegetation Treatments and Timber Sales

The BLM and USFS manage vegetation resources for resistant and resilient ecological conditions including healthy, productive, and diverse populations of native or desirable nonnative plant species appropriate to the site characteristics. Vegetation treatments is emphasized in areas that have the best potential to maintain desired conditions or respond and return to the desired range of conditions and mosaic upon the landscape, using all available current or future tools and techniques. Identified treatments and timber sales are as follows:

Within the WRNF, spruce beetle infestation, or aspen mortality have resulted in substantial mortality in mature forests on the WRNF. Currently, all populations of bark beetles are at endemic levels and aspen decline is limited within the lease area (USFS 2014a). Vegetation treatment projects have occurred to remove deadfall and hazardous trees. The CRVFO is on the western edge of the current mountain pine beetle infestation; relatively few acres have been infected yet (BLM 2014b). The BLM and USFS have conducted a number of vegetation treatments (using mechanical treatment, prescribed fire or other techniques) to improve wildlife habitat, address sudden aspen decline, or reduce hazardous fuels. Recent projects include the East Sopris Fuels Reduction Project (3000 acres in the Big Game CIAA treated between 2008 and 2012; BLM 2008a); Four Mile Fuels Reduction Project (77 acres in the HUVC-12 and Big Game CIAAs; BLM 2008b), and the Reservoir Gulch Prescribed Burn (1,100 acres in all CIAAs; BLM 2010).

There are approximately 89,000 acres infested with invasive plants and there are 42 known species of invasive plants (USFS 2007a). The WRNF treats approximately 1,000 acres each year. Priority areas are those where recent soil disturbance has occurred. On BLM lands, treatment of invasive and noxious weeds is guided by the BLM’s Final Programmatic EIS for Vegetation Treatment on Bureau of Land Management Lands in 17 Western States. The CRVFO weed program treats approximately 800 acres/year. Weed species that are currently rare within the CRVFO planning area receive the highest priority for treatment. Rare species include spotted and diffuse knapweed, Dalmation toadflax, and jointed goatgrass (BLM 2014b).

There have been approximately 3,620 acres of timber sales within the WRNF, of which approximately 1,150 acres were clearcut. The remainder was sanitation/salvage or shelterwood harvests (USFS 2014a). Within the CRVFO, the annual allowable harvest is 1.8 MMBF in the CRVFO; however, harvest levels have averaged less than 10,000 board feet per year in the last 5 years (BLM 2014b).

B.2.2.3 Resource Management Plan Amendments

The CRVFO released a new Resource Management Plan (RMP) in July 2015. The approved RMP has a mixed use focus that allocates public land resources among competing human interests, land uses, and the conservation of natural and cultural resources. Key elements with implications for this analysis include:

- Comprehensive Air Resources Protection Protocol (CARPP) to implement an adaptive management strategy for protecting air resources, monitoring air quality, and tracking emissions for comparison against the most recent regional air quality model results.
- No surface occupancy (NSO) stipulation for municipal watersheds and public water supplies that now includes protections of any public water supply that has completed (or is in the process of completing) a Source Water Assessment through the Colorado Department of Public Health and Environment (CDPHE) source water protection program
- CSU stipulation to protect (1) the secondary zone of a source water protection area for a permitted public water system, or (2) greater than 1,000 horizontal feet but less than 2,640 horizontal feet of a classified surface water supply stream segment (as measured from the average high water mark of a waterbody) for a distance of 5 miles upstream of a public water supply intake with the classification “Water Supply” by the State of Colorado.
- NSO stipulations with protections for water quality, wetlands, riparian zones, aquatic wildlife, and shorebird habitat now written as a single NSO stipulation for perennial waterbodies and riparian zones.
- A CSU stipulation that covered riparian and wetland vegetation to a distance of 500 feet from the edge of the riparian and wetland zone was replaced with (1) an NSO stipulation CRVFO-NSO-5 which applies within 328 feet (100 meters) from the edge of riparian vegetation, and (2) a CSU stipulation CRVFO-CSU-4, which applies from 328 feet to 500 feet beyond the riparian vegetation.
- A NSO stipulation for priority wildlife habitat was revised to include state wildlife areas
- The NSO stipulation with a 100-meter buffer around all BLM sensitive plants was replaced with a revised stipulation that provides a 200-meter buffer (656 feet) for those BLM sensitive plants that occur within ACECs.
- A CSU stipulation providing a 100-meter buffer (328 feet) around Harrington’s penstemon habitat outside ACECs was been expanded to include all BLM sensitive plant species outside ACECs.
- Canada lynx landscape linkages were designated as ROW avoidance areas.

All stipulations from the CRVFO Final RMP have been considered in the cumulative impact analysis.

B.3 Reasonably Foreseeable Future Actions

Reasonably foreseeable future actions (RFFAs) are those for which there are existing decisions, funding, formal proposals, or which are highly probable, based on known opportunities or trends. RFFAs within each CIAAs that have potential for similar impacts to those analyzed in this chapter for each resource are summarized below.

B.3.1 Actions with Surface Disturbance, Water Use or Transportation Impacts

B.3.1.1 Oil and Gas Development **RFFAs**

The WRNF, GMUGNF, CRVFO, GJFO, and the WRFO, have identified lands available for oil and gas leasing that fall within some or all of the CIAAs. Each agency has developed an RFDS for future oil and gas development within its administrative boundaries. Estimated long-term surface disturbance within each CIAA is presented in **Table B-3.** Water usage associated with the each RFDS is disclosed in **Table B-4.** Associated transportation requirements are disclosed in **Table B-5.** Each RFDS and the projections and assumptions used to calculate surface disturbance by CIAA is discussed in more detail in the sections following the table.

Table B-3 Long-term Surface Disturbance from Oil and Gas Development by CIAA

Management Area	Estimated Future Disturbance by CIAA (acres/percent)[1, 2]					
	Lease+2 Miles	**HUC-12**	**Big Game**	**Range**	**Lynx**	**Sage-grouse**
In and around Zones 1, 2, and 3						
USFS WRNF RFD-Glenwood Springs FO	496 / <1	496 / <1	496 / <1	496 / <1	496 / <1	0
USFS WRNF RFD-Grand Junction FO	94 / <1	94 / <1	94 / <1	94 / <1	94 / <1	0
USFS GMUGNF RFD	23 / <1	23 / <1	23 / <1	0	0	0
BLM CRVFO RFD-excluding RPPA	6,893 / 2	13,256 / 2.2	13,256 / <1	0	0	0
BLM RPPA	0	382 / <1	0 / 0	0	0	0
BLM GJFO RFD	71 / <1	560 / <1	1,897 / <1	0	0	71 / <1
In and around Zone 4						
BLM WRFO RFD	9 / <1	43 / <1	625 / <1	9 / <1	97 / <1	0
TOTAL	**7,586 / 2**	**14,854 / 2.5**	**16,391 / <1**	**599/ <1**	**687 / <1**	**71 / <1**

[1] Disturbance acreages do not include projects for which no acreage of surface disturbance has been defined.

[2] The Special Designations and Lease Area CIAAs are not included in this table because those CIAAs comprise only lands within the existing leases, and future oil and gas development on the existing leases is already considered in Chapter 2.0 of this EIS as part of the alternatives.

Source: BLM 2014c, 2012, 2008c; USFS 2004; WRNF 2010a.

Table B-4 Projected Water Use from Oil and Gas Development

RFD Well Projections in Garfield, Mesa, and Pitkin Counties[2]	Estimated water use (acre-feet)[1]	
	Drilling (fresh)	Completion (recycled)
USFS WRNF RFD-Glenwood Springs FO (514 wells, of which 21 would be horizontally drilled)	396	4,798
USFS WRNF RFD-Grand Junction FO (56 wells)	43	361
USFS GMUGNF RFD (27 wells)	21	174
BLM CRVFO RFD-excluding RPPA (14,342 wells)	11,043	92,362
BLM RPPA (5,470 wells)	4,212	35,227
BLM GJFO RFD (8,557 wells of which 3,433 would be horizontally drilled wells)	6,589	298,369
TOTAL	**22,304**	**431,291**

[1] Projected water use assumes that most or all wells would be vertical drilled except as noted. Water use is assumed to be the same as outlined in Chapter 2.0. Vertical/directional: drilling- 0.77 acre-feet per well (freshwater); completion- 6.44 acre-feet per well (recycled). Horizontal: drilling 3.22 acre-feet per well (freshwater); completion-77.3 acre-feet per well (recycled).

[2] BLM WRFO is excluded from water use estimates because it is located in Rio Blanco County. As discussed in Section 3.5, Water Resources, the water use analysis focuses on Garfield, Mesa, and Pitkin counties because this is where the majority of the leases are located. Within consideration of the 2,120 wells forecasted within the WRFO, total freshwater use would increase to 23, 396 acre-feet and recycled water use would increase to 200,193 acre-feet.

Source: BLM 2014c, 2012, BLM 2008c; USFS 2004; WRNF 2010a.

Table B-5 Projected Transportation Requirements from Oil and Gas Development

RFD Wellpad Projections	Estimated truck trips		
	Drilling	Completion	Reclamation
Regions 1, 2, 3			
USFS WRNF RFD-Glenwood Springs FO (514 wells on 75 pads, of which 3 pads would be for 21 horizontally drilled wells)	21,900	28,635	4,050
USFS WRNF RFD-Grand Junction FO (56 wells on 25 pads)	6,650	9,425	1,350
USFS GMUGNF RFD (27 wells on 27 pads)	7,182	10,179	1,458
BLM CRVFO RFD-excluding RPPA (14,342 wells on 2,049 pads)	545,034	772,473	110,646
BLM RPPA (5,470 vertical wells on 274 pads)	72,884	103,298	14,796
BLM GJFO RFD (8,557 wells on 1,824 pads, of which 373 pads would be for 3,433 horizontally drilled wells)	727,634	732,408	98,496
Region 4			
BLM WRFO RFD (21,200 vertical wells on 2,556 wellpads)	679,896	963,612	138,024
TOTAL	**2,061,180**	**2,620,030**	**368,820**

[1] Transportation estimates assume that wells would be vertical or directional unless otherwise indicated. Vertical or directional wells are assumed to require 266 trips for drilling, 377 trips for completion, and 54 trips for reclamation per wellpad. Horizontal wells are assumed to require 916 trips for drilling, 497 trips for completion, and 54 trips for reclamation per wellpad.

Source: BLM 2014c, 2012, 2008c; USFS 2004; WRNF 2010a.

White River National Forest

The administrative boundary of the WRNF overlaps with the administrative boundaries of the CRVFO (formerly the Glenwood Springs FO), Kremmling FO, Little Snake FO (very little overlap), GJFO and WRFO. The RFDS for the WRNF (USFS 2010a) was developed with consideration of the potential for oil and gas development within each of these FOs (as identified in their respective RFDs), since the FOs cover portions of the WRNF on which oil and gas activity is projected. The WRNF RFDS projects a total of 1,058 acres of long-term disturbance (from 1,014 wells from 179 wellpads within the WRNF). This disturbance acreage is inclusive of roads, pipelines, and related facilities. The RFDS for the WRNF further divides this disturbance as follows:

- 845 acres of long-term disturbance on NFS lands within the CRVFO (872 wells);
- 168 acres of long-term disturbance on NFS lands within the GJFO (132 wells);
- 45 acres of long-term disturbance on NFS lands within the Little Snake FO/WRFOs (10 wells); and
- No disturbance or development on NFS lands within the Kremmling FO.

As discussed in Chapter 2.0, the WRNF RFDS was used to estimate the number of wells likely to be developed within the 65 existing leases under evaluation (444 wells). Of this total, 358 wells would be on NFS lands within the Glenwood Springs FO, 76 wells would be on NFS lands within the GJFO (within leases 066926, 066733, 066732 070013, 072157, and 066917), and 10 wells would be on NFS lands within the Little Snake FO/WRFO (within lease 066926).

The remaining 570 wells projected in the RFDS, which are considered to be RFFAs, could occur in any area of the WRNF outside of the existing leases that is open to oil and gas leasing (94,123 acres as designated in the 2014 ROD for Future Leasing within the WRNF; WRNF 2014a). These areas are located in the portions of the WRNF with the highest identified oil and gas development potential, which are located adjacent to the existing leases. The remaining wells would be divided as follows:

- 496 acres of long term disturbance (514 wells, of which 21 would be horizontally drilled) on NFS lands within the Glenwood Springs FO;
- 94 acres of long term disturbance (56 wells) on NFS lands within the Grand Junction FO (assuming that all development of leases 066926, 066733, 066732 070013, 072157, and 066917 would occur within those portions of the lease within the Grand Junction FO;
- No reasonably foreseeable development on NFS lands within the Kremmling FO or Little Snake/WRFOs.

Given the location of future leases and areas of high mineral potential, all 496 acres of surface disturbance on NFS lands within the Glenwood Springs FO could occur within the Big Game, HUC-12, Lease+2 Mile Buffer, Range, and Lynx CIAAs, and all 94 acres of surface disturbance on NFS lands within the Grand Junction FO could occur within the Big Game, HUC-12, Lease+2 Mile Buffer, Lynx, and Range CIAAs. This acreage is included in **Table B-3.** Water usage associated with the WRNF RFDS (which, excluding the existing leases would be 570 wells, of which 21 wells would be horizontal) is disclosed in **Table B-4.** Transportation requirements associated with the full RFDS are disclosed in **Table B-5**.

GMUGNF National Forest

The Big Game HUC-12 and Lease+2 Mile Buffer CIAAs include portions of the Grand Mesa National Forest (GMNF), which is a part of the GMUGNF. The RFDS for the GMUGNF (USFS 2004) anticipates development of 45 vertical wells, 27 of which would be within the GMNF. Of these 27 wells, 15 wells would be associated with a Geographic Area Proposal located near Spaulding Peak. This area is not included in any CIAAs. Locations of the remaining 12 wells are not known. There is potential for all 12 wells to fall within the Big Game, Lease+2 Mile Buffer, and HUC-12 CIAAs, since these CIAAs include much of the identified high development potential areas within the GMUGNF. The long term surface disturbance associated with 12 vertical wells would be 23 acres, including 7 miles of road (USFS 2004). This acreage is included in **Table B-3.** Water usage associated with the full GMNF RFDS (27 wells) is disclosed in **Table B-4.** Transportation requirements associated with the full RFDS are disclosed in **Table B-5**.

CRVFO (formerly the Glenwood Springs FO)

The RFDS developed for the CRVFO (BLM 2008c) projected a total of 5,768 wells to be developed on BLM mineral estate (not including NFS lands), with an additional 9,024 wells to be developed on private lands. Locations of wells were not determined, with the exception of 450 wells projected to occur within the Roan Plateau Planning Area (RPPA). The RPPA estimate was superseded by a new RFDS for the RPPA (BLM 2014c) that projects 5,470 federal and fee wells within the RPPA. Of this total, 1,650 wells would be located “above the rim” (i.e., above top of the cliffs), and the remaining 3,820 well would be located “below the rim” (BLM 2014c).

Development of the CRVFO RFDS for BLM and private lands would include lands within the Big Game, HUC-12 and Lease+2 Mile Buffer CIAAs. It is assumed that none of the disturbance would fall within the Range and Lynx CIAAs because these CIAAs are largely confined to NFS lands (the development of which has been considered separately).

With consideration of the 2005 CRVFO RFDS and 2014 RPPA RFDS and using the disturbance calculations included in each of these RFDSs, long term surface disturbance outside of NFS lands would be as follows:

- CRVFO excluding the RPPA: 13,256 acres of surface disturbance (from 5,318 BLM wells and 9,024 private wells on a total of 2,049 wellpads). Locations of the projected development are not disclosed but most high potential areas and existing development outside of the RPPA are in and around the existing leases (within the Big Game and HUC-12 CIAAs).The Lease+2 Mile Buffer comprises about 84 percent of the Big Game CIAA in this area. Surface disturbance within this CIAA has therefore been scaled similarly (to 6,893 acres).
- RPPA: 1,039 acres of surface disturbance (from 5,470 wells on 274 wellpads) in the entire RPPA. While most of the RPPA is outside of any of the CIAAs, the southern half of the area below the rim is within the HUC-12 CIAA. Assuming that the northern and southern halves of the area below the rim would be developed equally, there would be 382 acres of surface disturbance (from 1,910 wells on 96 wellpads) within the southern half of the area below the rim.

This acreage is included in **Table B-3**. Water usage associated with the full CRVFO RFDS (19,812 wells, including the revised RPPA estimate) is disclosed in **Table B-4**. Transportation requirements associated with the full RFDS are disclosed in **Table B-5**.

The RFDS for the CRVFO also predicts 40 geophysical surveys of 8,300 acres each, for a total temporary surface disturbance of 3,320 acres. All areas of disturbance would be fully reclaimed; therefore this acreage is not included in **Table B-3**.

Grand Junction FO

The Grand Junction FO contains 1,459,391 acres open to leasing. The RFDS developed for the Grand Junction FO (BLM 2012) projects 8,557 producing shale and coal bed methane wells within the FO lands in the next 20 years, of which 3,433 would be horizontally drilled. The long-term disturbance associated with this development scenario would be 6,414 acres.

Approximately 379,686 acres of the Big Game CIAA fall within the Grand Junction FO (all in GMU 421). This portion of the Big Game CIAA contains the following types of expected oil and gas exploration and development:

- Conventional oil and gas development: about 50 percent of all areas with very high development potential, 66 percent of all areas with high development potential and about 25 percent of all areas with moderate development potential;
- Mancos shale gas play: about 33 percent of all areas with high to moderate potential for development; and
- Coalbed natural gas development: 100 percent of all areas with high development potential and less than 20 percent of all areas with moderate development potential.

Based on upon the disturbance assumptions contained in the RFD, which consider both development potential and development type, there would be about 3,063 wells within the Big Game CIAA. Total long-term surface disturbance would be 2,013 acres. After excluding the surface disturbance projected to occur on NFS lands in forest-specific RFDs (94 acres on the WRNF and 23 acres on the GMUGNF, see above), there would be approximately 1,897 acres of long term surface disturbance within the Big Game CIAA.

Within the Grand Junction FO, the HUC-12 CIAA, Sage-grouse CIAA and Lease+2 Mile Buffer CIAA, while smaller than the Big Game CIAA, are located in the same area and generally contain the same development type and potential. The portion of the HUC-12 CIAA within the Grand Junction FO is approximately 30 percent of the Big Game CIAA. The portion of the Sage-grouse CIAA within the Grand Junction FO is approximately 4 percent of the Big Game CIAA. The portion of the Lease+2 Mile Buffer CIAA within the Grand Junction FO is approximately 4 percent of the Big Game CIAA. After scaling the reasonably foreseeable development within the Big Game CIAA to these percentages, there would be about 560 acres of long term surface disturbance within the HUC-12 CIAA and 71 acres within the Sage-grouse and Lease+2 Mile Buffer CIAAs. This acreage is included in **Table B-3.** Water usage associated with the full Grand Junction FO RFDS (8,557 wells, which 3,433 wells would be horizontal) is disclosed in **Table B-4.** Transportation requirements associated with the full RFDS are disclosed in **Table B-5**.

WRFO

The WRFO contains the Zone 4 lease, which is located on NFS lands near the east border of the FO. The RFDS for the WRFO initially projected 14,400 wells on 2,146 wellpads; based on input from the oil and gas industry, a second RFDS was included that forecasted 21,200 wells on 2,556 wellpads (BLM 2007). There would be 31,257 acres of surface disturbance associated with this scenario. There is no information in the RFDS regarding the location of future development; however, the RFDS is largely based on the Mesaverde gas play, which is located to the west and outside of the CIAAs. With the exception of a “finger” of high/medium oil and gas potential located near the existing lease, the area within the CIAAs is classified as having low or no oil and gas potential (WRNF lands east of the existing lease are largely within the Flat Tops Wilderness Area and are not open for oil and gas development). Of the 5,800 existing boreholes mapped in the RFD, about 98 percent are located with the western two-thirds of the FO and outside of any CIAA. Assuming a similar distribution of future development, there would be about 625 acres of surface disturbance from 425 wells within the eastern third of the FO in areas open to leasing. This area is roughly analogous to the portion of the Big Game CIAA that is located in and near the Zone 4 lease (2 GMUs totaling 585,770 acres), and the analysis assumes that all 625 acres of surface disturbance could occur within the Big Game CIAA.

The Lynx, HUC-12, Range, Lease+2 mi Buffer, and Special Designation CIAAs comprise about 16, 7, 2, 2, and 0.04 percent, respectively, of the Big Game CIAA. After scaling the reasonably foreseeable development within the Big Game CIAA to these percentages, there would be about 97 acres of long-term surface disturbance within the Lynx CIAA, 43 acres of long term surface disturbance within the

HUC-12 CIAA, and 9 acres of surface disturbance within the Range and Lease+2 mi Buffer CIAAs. This acreage is included in **Table B-3.** Water usage is not disclosed in **Table B-4**, because this FO is located in Rio Blanco County, which is not considered in the water use analysis. Transportation requirements associated with the full WRNF RFDS are disclosed in **Table B-5**.

B.3.1.2 Recently Approved and Pending APDs

It is important to note that the RFDS forecasts development over the next 10 to 20 years; however, not all development would occur immediately or at the same time. The COGCC database was used to identify recently approved and pending APDs in order to understand what portion of the projected disturbance identified in **Table B-3** might be developed within the next few years. Using the disturbance calculations for wellpads and associated roads and pipelines contained in Chapter 2.0, disturbance acreages are presented in **Table B-6**.

The water use disclosed in **Table B-4** and the transportation requirements disclosed in **Table B-5** also would occur over time. As of May 2015, there were 1,529 recently approved and pending APDs within Garfield, Mesa and Pitkin counties. Development of these wells would require 1,177 acre-feet of freshwater for drilling and 9,847 acre-feet of recycled water for completion. Assuming all wells are vertically or directionally drilled and that there would be an average of 7 wells per wellpads, development of these APDs would require 26,752 truck trips for drilling, 37,915 trips for completion and 5,431 trips for reclamation.

Table B-6 Long-term Surface Disturbance from Recently Approved or Pending APDs by CIAA

Management Area	Estimated Future Disturbance by CIAA (acres/percent)[1, 2]					
	Lease+2 Miles	**HUC-12**	**Big Game**	**Range**	**Lynx**	**Sage-grouse**
In and around Zones 1, 2, and 3	242 / <1	704 / <1	2,300 / <1	14 / <1	105 / <1	7 / <1
In and around Zone 4	0	0 / 0	10 / <1	0 / 0	0 / 0	0 / 0
TOTAL	**242 / <1**	**704 / <1**	**2,310 / <1**	**14 / <1**	**105 / <1**	**7 / <1**

[1] The Special Designations and Lease Area CIAAs are not included in this table because those CIAAs comprise only lands within the existing leases, the development of which is already considered in this EIS in the alternatives.

[2] As of May 2015, recently approved and pending APDs by CIAA were as follows: Lease+2 miles-1 recently approved APD and 68 pending APDs; Big Game CIAA- 591 recently approved APDs and 69 pending APDs; HUC-12 CIAA- 197 recently approved APDs and 4 recently approved APDs; Range- 2 recently approved APDs and 2 pending APDs; Lynx- 26 recently approved APDs and 4 pending APDs; and Sage-grouse- 2 recently approved APDs. Long term surface disturbance assumptions: Wellpad - 0.5 acre per well, road -3 acres per well (see Chapter 2.0).

Source: COGCC 2015.

B.3.1.3 Other Development RFFAs

The BLM ePlanning NEPA Register was used to obtain information regarding RFFAs on BLM lands. USFS SOPA and NOPA documents were used to obtain information regarding RFFAs on National Forest System lands. **Table B-7** provides a summary anticipated surface disturbance by CIAA; the following sections describe each project in more detail. All of the identified RFFAs are in Zones 1, 2, and 3. Oil and gas development projects were not included, as they are assumed to be included in the RFDSs described in Section B.3.1.1. Vegetation treatments, which do not necessary have surface disturbance or adverse impacts to resources, are discussed separately in

Table B-7 Long-term Surface Disturbance from Non-Oil and Gas Development by CIAA

	Section B.3.2.1. Disturbance Acreages by CIAA (acres / percent)[1, 2]	
Management Area	**Lease, Lease+ 2 mi, HUC-12. Lynx, Sage-grouse, Range, Special Desig.**	**Big Game**
Hunter Reservoir Enlargement	0	61 / <1
Young’s Ditch trail reroute	0	<0.5 / <1
CDOT Highway 133 Debris Dump Site and Placita Roadside Landscaping	0	9 / <1
Rio Grande Connection Trail Reroute	0	<0.5 / <1
Trickel Park Road Improvement Project	0	9 / <1
TOTAL	**0**	**99 / <1**

[1] Disturbance acreages do not include projects for which surface disturbance is located with previously disturbed areas or projects for which no acreage of surface disturbance has been defined.

[2] While these projects so occur within the CIAA for Socioeconomics, this CIAA is not included in this table because surface disturbance is not an impact indictor used for impact analysis of this resources. See Section 4.17 for the impact indicators related to the cumulative impacts analysis for Socioeconomics.

Source: BLM 2015d; USFS 2015a,b; 2014b; 2007b.

National Forest System Lands

The WRNF SOPAs and NOPAs for 2015 (USFS 2015a) identified the following projects with potential for surface disturbance within one or more of the CIAAs:

- Holy Cross Energy Underground Powerline: new underground powerline to the top of Sunlight ski area. Disturbance is anticipated to be limited to 1-foot-wide trenches within existing ski runs. The ski area is within the HUC-12, Big Game, Range and Lynx CIAAs, but is not included in surface disturbance calculations in **Table B-6** because the powerlines would be installed within existing disturbance areas.
- CDOT Highway 133 Debris Dump Site and Placita Roadside Landscaping: CDOT is proposing to permanently store natural road debris inside a 9.17-acre man-made loop in the highway east of McClure Pass on SH-133. Project also will fill in a 16.1-acre depression from original road construction and revegetate the old Placida fill site (USFS 2014b). The project is within the Big Game CIAA. New surface disturbance acreage is included in **Table B-6.**

The GMUGNF SOPAs and NOPAs for 2015 identified the following projects with potential for surface disturbance within one or more of the CIAAs:

- Hunter Reservoir Enlargement: Proposal to enlarge existing reservoir from 19 to 80 acres and improve/relocate the access road. 32 acres of wetlands would be inundated; and grass/forb/shrub and spruce/fire vegetation types also would be affected (USFS 2007b). The project is in the Big Game CIAA and is included in **Table B-6.**
- Young's Ditch trail reroute: closing 1.25 miles of trail along the banks of an existing ditch and creating a 0.9-mile section of trail as a new NFS trail route to Young's Lake (USFS 2015b). The project is within the Big Game CIAA. Assuming a 3-foot trail width, total new surface disturbance would be less than 0.5 acre and is included in **Table B-6.**
- Trickel Park Road Improvement Project: Re-conditioning of the surface of Trickel Park Road #121 from Alexander Lake Lodge to the North Forest Boundary, including 1 mile of new pavement from the intersection with FDR #123 to East Crag Crest Trailhead (USFS 2015b). Portion of this project may be within the Big Game CIAA. Assuming a road width of 24 feet, there would be approximately 9 acres of new surface disturbance, which is included in **Table B-6.**

BLM Lands

The BLM ePlanning NEPA Register for fiscal year 2015 and the CRVFO FO webpage identified 49 projects within the CRVFO and 93 projects initiated in previous years that are still reasonably foreseeable. Of these projects, three RFFAs were identified as having potential for surface disturbance in one or more CIAAs that is not related to oil and gas development.

- Jolley Mesa Natural Gas Pipeline: natural gas pipeline located almost entirely on private lands, with 18 acres of proposed disturbance, all located within previously disturbed areas (BLM 2015c). The area is within the Big Game CIAA, but is not included in surface disturbance calculations in **Table B-6** because the pipeline would be installed within existing disturbance areas.
- Rio Grande Connection Trail Reroute: reroute of a trail with steep, eroding and unsustainable reaches and trespasses on private property; 1.3 miles of new trail would be constructed and maintained and 0.75 mile of existing trail would be closed to mechanized and motorized use (BLM 2015d). The proposed route would be up to 3 feet wide. The project is within the Big Game CIAA. Total new surface disturbance would be less than 0.5 acre and is included in **Table B-6**.
- Porter Ditch enlargement (BLM 2015e): The project is within the Big Game, HUC-12, and Lynx CIAAs; however, the BLM has not yet identified any acreage disturbance for the project. Accordingly, this project is not included in **Table B-6.**

The ePlanning NEPA Register for fiscal year 2015 identified 14 RFFAs within the Grand Junction FO. None of the RFFAs are in any of the CIAAs.

The ePlanning NEPA Register for fiscal year 2015 identified 43 RFFAs within the Grand Junction FO. Of these projects, only the Wilson Creek Trail Project has potential for surface disturbance within a CIAA. The project proposes to close trails that are causing resource damage and construct sustainable trails open to motorized vehicles up to 50 inches wide. The project is within the Big Game CIAA; however, the BLM has not yet identified any acreage disturbance for the project. Accordingly, this project is not included in **Table B-6.**

B.3.2 Other USFS District or BLM Field Office Actions

The following sections describe other types of RFFAs within the CIAAs. These actions are not included in **Table B-6** because they do not necessarily result in surface disturbance; may not have adverse impacts on all resources; and in some cases may have a countervailing effect on cumulative impacts

B.3.2.1 Vegetation Treatments and Hazardous Fuels Reduction RFFAs

Table B-8 provides a summary by CIAA of vegetation treatments and hazardous fuels reduction RFFAs for which acreage information is available. All of the identified RFFAs are in Zones 1, 2, and 3. Each project is discussed in more detail in the following sections following the table.

NFS Lands

There are three vegetation treatments and hazardous fuels reduction projects that would occur within NFS lands in one or more CIAAs:

- South Rifle Habitat Enhancement Project (USFS 2014c): wildlife habitat improvements on approximately 6,000 acres across the south side of the Rifle Ranger District. Treatments include cutting sagebrush, oakbrush, and mountain shrub and prescribed fire in aspen, pinyon-juniper, and Douglas fir as follows:
  - Battlefield Prescribe burn units: (up to 3,000 acres): In Big Game, HUC-12, Range, Special Designations, Lynx, and Lease Area CIAAs.
  - Oakbrush/mountain shrub mechanical treatments (2,000 acres): In Big Game, HUC-12, Range, Lynx, and Lease Area CIAAs.
  - Sagebrush Enhancement Projects (up to 600 acres): In Big Game, HUC-12, Range, Special Designations, Lynx, and Lease Area CIAAs.
  - Bighorn Sheep Travel Lane Mechanical Treatments (up to 400 acres): locations not identified but assumed to occur in Big Game, HUC-12, Range, Special Designations, Lynx, and Lease Area CIAAs.
- Aspen/Sopris Wildlife Habitat Improvement Project (WRNF): prescribed fire and mechanical treatments between 2015 and 2018 in identified blocks of forest, shrubland, and grassland vegetation types to improve wildlife browse and foraging habitat (USFS 2010b). Portions of the Glenwood Treatment Area are within the Big Game and HUC-12 CIAAs. Portions of the Crystal River Treatment Area are within the Big Game and Lynx CIAAs. With consideration of both treatment areas, there would be approximately 11,500 acres of treatment within the Big Game CIAA (all within GMU 43), 2,100 acres of treatments areas within the HUC-12 CIAA (in Outlet Roaring Fork River and the Edgerton Creek-Crystal River subwatersheds), and 6,370 acres within the Lynx analysis area (in the Crystal West LAU). These acreages are included in **Table B-7.**
- Spruce Beetle Epidemic and Aspen Decline Management Response Project (GMUGNF NF): The GMUGNF proposes between 4,000 to 6,000 acres of commercial harvest treatments over a 10-year period to treat affected stands, improve the resiliency of stands at risk of these large-scale epidemics and reduce the safety threats of falling, dead trees and large-scale wildfires. Locations have not yet been defined; focus areas for hazard mitigation include open roads; in and around campgrounds, developed and dispersed recreation sites, or other administrative facilities; within ski areas boundaries, power transmission lines ROW and border zones, and communication, water, pipeline, and other utility corridors; near other inventoried infrastructure that could be at risk from falling trees; and within wildland-urban interface. There also is focus on area where commercial mechanical harvest may occur (USFS 2014d).

Table B-8 Vegetation Treatments and Hazardous Fuels Reduction RFFAs by CIAA

Treatment Project	Disturbance Acreages by CIAA (acres/percent)[1, 2]							
	Lease	**Lease +2 mi.**	**HUC-12**	**Big Game**	**Lynx**	**Sage-grouse**	**Range**	**Special Desig.**
South Rifle Habitat Enhancement Project	6,000 / 7	6,000 / 2	6,000 / 1	6,000 / <1	6,000 / 1	0 / 0	6,000 / 2	3,000 / 9
Aspen/Sopris Wildlife Habitat Improvement Project	0	0	2,100 /<1	11,500 / 1	6,370 / 1	0 / 0	0 / 0	0 / 0
Lookout Mountain Communications Site Hazardous Fuels Reduction Project	0	0	25 / <1	25 / <1	0 / 0	0 / 0	0 / 0	0 / 0
Spruce Creek Oakbrush Thinning Project	0	0	100 / <1	100 / <1	100 / <1	0 / 0	0 / 0	0 / 0
Uncle Bob Oakbrush Thinning Project	0	0	200 / <1	200 / <1	200 / <1	0 / 0	0 / 0	0 / 0
Uncle Bob Mountain Road Hazardous Fuels Treatment Project	0	0	2,100 / <1	2,100 / <1	2,100 / <1	0 / 0	0 / 0	0 / 0
Cedar Springs II Vegetation Treatment Project	0	0	800 / <1	800 / <1	0 /	0 / 0	0 / 0	0 / 0
Cedar Mountain Fuels Reduction Project	0	0	667 /<1	667 / <1	0 /	0 / 0	0 / 0	0 / 0
TOTAL	**6,000 / 7**	**6,000 / 2**	**11,992 / 2%**	**21,392 / 1**	**14,770 / 3**	0 / 0	**6,000 / 2**	**3,000 / 9**

[1] Disturbance acreages do not include projects for which no acreage of surface disturbance has been defined.

[2] For each project, the total projected treatment acreages have been included within each CIAA because there is significant overlap between the CIAAs and because treatments areas and treatment locations have not been finalized and therefore have potential to occur within any of the CIAAs.

Source: BLM 2015f,g,h; Larson 2015a,b; Ringer 2015; USFS 2014c,d; WRNF 2010b.

Based on maps showing recent spruce beetle activity and areas of timber suitability (USFS 2013), there is potential for some treatments to occur in the Big Game, Lynx, Special Designations, and potentially the HUC-12 CIAAs; however, these areas are largely within roadless areas and do not contain many of the focus areas identified by the USFS. Accordingly, treatment acreage is not included in **Table B-7**.

BLM Lands

The CRVFO proposes to conduct the following six vegetation treatment and hazardous fuels reduction projects:

- Lookout Mountain Communications Site Hazardous Fuels Reduction Project: fuel reduction project to maintain the effectiveness of an 11-acre treatment area and remove vegetation in a mosaic pattern on an additional 14 acres (BLM 2015f). The project is located east of Glenwood Springs, within the Outlet Roaring Fork River subwatershed. This project would be within the Big Game and HUC-12 CIAAs.
- Spruce Creek Oakbrush Thinning Project: thinning between 30 percent and 50 percent of dense oakbrush stands totaling approximately 100 acres in the Spruce Creek area. The project was identified by Colorado Parks and Wildlife (CPW) and BLM as mitigation for year-round drilling on BLM lands (BLM 2015g). The project would be within the HUC-12, Big Game, and Lynx CIAAs.
- Uncle Bob Oakbrush Thinning Project: thinning between 30 percent and 50 percent of dense oakbrush stands totaling approximately 200 acres to forage quantity and quality for big game ungulates (deer and elk). The project was identified by CPW as mitigation for the Bull Mountain pipeline, which was constructed on BLM and White River National Forest lands (BLM 2015h). The project would be within the HUC-12, Big Game and Lynx CIAAs.
- Uncle Bob Mountain Road Hazardous Fuels Treatment Project: 2,110 areas targeted for mechanical treatment and/or prescribed fire (Larson 2015a). The project would be within the HUC-12, Big Game and Lynx CIAAs.
- Cedar Springs II Vegetation Treatment Project: 800 acres of pinyon-juniper vegetation removal (Ringer 2015). The project would be located within the Big Game and HUC-12 CIAAs.
- Cedar Mountain Fuels Reduction Project: removal of pinyon-juniper vegetation in mule deer winter range via hydro-axing (283 acres) and hand-thinning (384 acres; Larson 2015c). The project would be located within the Big Game and HUC-12 CIAAs.

Treatment acreage is included in **Table B-7**. The ePlanning NEPA Register for fiscal year 2015 did not include any proposed vegetation treatments in any of the CIAAs within the Grand Junction of WRFOs.

B.3.2.2 Battlement Reservoir Reconstruction

The Battlement Reservoirs are a chain of seven reservoirs, south of Parachute, Colorado. Four of the seven dams have breached to some extent, and all the dams are in unsatisfactory condition. The USFS proposes to reconstruct a few of the reservoirs in the near future. Two to three reservoirs will be maintained shallow for wildlife habitat (USFS undated). The Battlement Reservoirs fall within the HUC-12 CIAA and the Big Game CIAAs.

B.3.2.3 Livestock Grazing

The continuation of livestock grazing at current levels on a long-term basis on WRNF and BLM grazing allotments is reasonably foreseeable .BLM NEPA register and USFS SOPAs have identified a number of grazing allotment reauthorization projects, some of which are within the Big Game and HUC-12 CIAAs.

B.3.3 County Actions

The project area includes portions of Garfield, Mesa, Pitkin, and Rio Blanco counties. Garfield County contains portions of lease Zones 2 and 3. The east planning area of Mesa County includes all of the Zone 1 leases as well as leases within Zones 2 and 3. The majority of the Zone 3 leases are in Pitkin County. The Zone 4 lease is located in eastern Rio Blanco County.

County actions considered in the cumulative impacts assessment of lease development include future land use planning applicable to oil and gas development, future traffic projections; transportation improvement plans affecting the proposed transportation corridors, and land or infrastructure development projects in the portions of the CIAAs outside the existing leases.

B.3.3.1 Garfield County

The Garfield County Comprehensive Plan (2013) recognizes energy development as a dominant industry with potential for strong job growth and considerable benefit to the economic health of the county over the next 20 years. The future land use map includes a Resource Production/Natural (RPN) land use designation, which is applied to agriculture and grazing land used primarily for oil, gas, oil shale, coal mining, gravel mining, including support buildings and facilities needed for the natural resource extraction industry, and other business uses that can be adequately buffered from adjacent incompatible uses. The Plan states that oil and gas facilities such as compressors are appropriate in all land uses so long as they meet the respective mitigation requirements of the Land Use Development Code. Comprehensive Plan strategies and actions to address the potential issues associated with mineral development include adoption of a Mineral Extraction Master Plan (Garfield County 2013).

Because the most affordable housing in the county will continue to be in the Colorado River Valley, the Garfield County Comprehensive Plan identifies continued long commutes (and attendant time and costs), traffic congestion (especially through the SH-82 corridor in Glenwood Springs), and road impacts. The Glenwood Springs Comprehensive Plan (2011) estimates 47,900 to 52,000 vehicle trips per day on Grand Avenue by 2035. The Plan states that absent any other significant traffic reductions or transportation capacity strategies, Grand Avenue would have to be widened to six lanes in order to accommodate this level of traffic (an undesirable option because of its significant negative impacts on the Downtown). Additionally, the Grand Avenue Bridge, which has been classified by the Colorado Department of Transportation as being functionally obsolete (though not structurally deficient) will need to be widened to four full lanes to optimize safety and traffic flow and to accommodate projected traffic levels (Glenwood Springs 2011).

The Glenwood Springs Comprehensive Plan also identifies the following RFFAs:

- Development of a new substation adjacent to the new wastewater treatment facility on the west side of the city; and
- Expansion of the existing landfill through the purchase of 62.5 acres of adjacent land from the BLM under the Recreation and Public Purposes Act (Glenwood Springs 2011).

Both of these projects would be in or near the HUC-12 and Big Game CIAAs.

B.3.3.2 Mesa County

The Mesa County Comprehensive Plan (2013) recognizes and seeks to protect its rural character. Within its east planning area (where the existing leases and CIAAs are located), the Plan identifies moderate to high agricultural, vegetation and wildlife values that need to be acknowledged in future land use planning and indicates that continued ranching may require the use of public lands to remain viable. There is no restriction on oil and gas development; however, the Plan identifies energy development as a key planning issue with potential to impact areas at levels not previously anticipated. Planning goals include coordination with federal land managers to protect, conserve and efficiently manage the county's public lands. Mesa County also has developed a Mineral and Energy Resources Master Plan (2011), which offers a mapping tool designed to allow the user to identify locations of sensitive landscapes, and outlines mitigation measures to reduce impacts to mapped sensitivities.

The Grand Valley 2040 Regional Transportation Plan Update (2014), which identifies investments and strategies to address transportation needs within Mesa County for the next 20 years, indicates that the Highway 6 and I-70 corridor north of De Beque (within the Transportation CIAA), is expected to experience heavy traffic impacts driven by energy-related development. The Plan identifies two critical regional priority projects anticipated to be implemented between now and 2040 in this area: a truck bypass and a new I-70 interchange, both in De Beque (Mesa County 2014).

B.3.3.3 Pitkin County

Future development is guided by the Pitkin County Comprehensive Plan (2003) and 11 Rural Area plans. Lands within the Lease Area, Big Game, Lynx, HUC-12, and Range CIAAs are generally guided by the Crystal River Valley Comprehensive Plan. The Big Game CIAA also includes portions of the Down Valley and the Snowmass-Capitol Creek Valleys Master Plans. There are no specific RFFAs discussed within any of the plans; however, as stated in the Pitkin County Comprehensive Plan, a unifying theme and overarching goal of all area sub-plans is to sustain the existing rural character of Pitkin County (Pitkin County 2003a):

- Crystal River Valley Master Plan goals include preservation of the natural environment and protection of rural character (specifically open space, wildlife habitat, water quality, and the Highway 133 viewshed); recognition of agriculture as an irreplaceable treasure; and limitation of growth consistent the physical carrying capacity, rural character, and natural and built environment of the valley (Pitkin County 2003b).
- Down Valley Comprehensive Plan goals include managing the rate of growth; preserving agricultural lands; and preserving environmental quality. The plan's Future Land Use Map designates about 40 percent of the lands in the planning area as "Agricultural/Wildlife Reserve." The plan also recommends that a scenic foreground be established for the lands that are highly visible from Highway 82 and Brush Creek Road (Pitkin County 1987).
- Snowmass-Capitol Creek Valleys Master Plan goals include enhancement and preservation of the dominant agricultural and rural residential character of the Snowmass/Capitol Creek valleys. The Plan specifically seeks to prevent mining, mineral exploration, oil and gas drilling and exploration, sand and gravel pits, rock crushers, concrete batch plants, and other extractive operations from occurring on private lands within the Caucus Area and, to the extent possible, discourages such activities on public lands (Pitkin County 2003c).

B.3.3.4 Rio Blanco County

The Rio Blanco Master Plan (2011) emphasizes protecting access to public lands, promoting the preservation of open lands, keeping rural spaces intact, and minimizing adverse agricultural impacts. While recognizing that resource extraction is important to the current and future county economy, the Plan states that new economic opportunities may emerge with the inevitable decline of finite natural resources and recommends that the county: 1) explore possibilities of new or expanded existing economic opportunities to decrease negative effects of unpredictable energy market; 2) create an economic transition plan including job retraining and business diversification aimed at long-term stability; and 3) direct attention to the mainstays of agriculture, outdoor recreation, tourism and the pristine environment (Rio Blanco 2011).

Relevant transportation goals include improvements to County Road 5 and the development of alternative routes into the Piceance Basin including Fourteen Mile Creek and County Road 122. The Plan also indicates that new development would be required to improve roadways commensurate with development induced traffic impact, and that energy companies should provide transportation in and out of the Piceance Basin from established carpool pick-up/drop-off points for large energy development projects requiring a substantial work force (Rio Blanco 2011).

References

Bureau of Land Management (BLM). 2015a. Legacy Rehost System (LR2000) Case Recordation for Garfield, Mesa, Pitkin, and Rio Blanco Counties as of April 22, 1015.

Bureau of Land Management (BLM). 2015b. U.S. Department of the Interior Bureau of Land Management State of Colorado website: Colorado River Valley Field Office Information. Available at: http://www.blm.gov/co/st/en/fo/crvfo/Office_Information.html.

Bureau of Land Management (BLM). 2015c. DOI-BLM-CO-N040-2015-0031-CX (390). Jolley Mesa Pipeline. Available at: https://www.blm.gov/epl-front-office/projects/nepa/44742/54980/59672/DOI-BLM-CO-N040-2015-0031-SCX1.jb.pdf.

Bureau of Land Management (BLM). 2015d. ePlanning DOI-BLM-CO-N040-2015-0009-EA (Trail Reroute -Rio Grand Connection).

Bureau of Land Management (BLM). 2015e. Colorado River Valley Field Office NEPA Register. Current Actions – (February 5, 2015): CO140-06-054 EA.

Bureau of Land Management (BLM). 2015f. BLM Colorado River Valley Field Office NEPA Register. Current Actions – (February 5, 2015): DOI-BLM-CO-N040-2015-0027-EA.

Bureau of Land Management (BLM). 2015g. ePlanning: DOI-BLM-CO-N040-2015-0060-CX (Spruce Creek Oakbrush Thinning Project).

Bureau of Land Management (BLM). 2015h. ePlanning. DOI-BLM-CO-N040-2015-0059-DNA (Uncle Bob Oakbrush Thinning for Bull Mountain Pipeline Mitigation)

Bureau of Land Management (BLM). 2014a. WRNF Communication Sites and Radio Base Repeater GIS data layer.

Bureau of Land Management (BLM). 2014b. Colorado River Valley Field Office – Proposed RMP/Final EIS. Chapter 3 Affected Environment. February 2014. Available at: http://www.blm.gov/co/st/en/BLM_Programs/land_use_planning/rmp/kfo-gsfo/colorado_river_valley.html.

Bureau of Land Management (BLM). 2014c. Reasonable Foreseeable Development Roan Plateau Planning Area. Prepared by Bruce Fowler and Pat Gallagher (Bureau of Land Management), 11/17/2014 Revision for updated surface disturbance calculations.

Bureau of Land Management (BLM). 2012. Reasonably Foreseeable Development Scenario for Oil and Gas Grand Junction Field Office, Colorado. United States Department of the Interior Bureau of Land Management. June 18, 2012

Bureau of Land Management (BLM). 2010. Reservoir Gulch Prescribed Burn Environmental Assessment. DOI-BLM-CO-N040-2009-0006 EA. BLM, Glenwood Springs Field Office. Decision Record signed February 2, 2010.

Bureau of Land Management (BLM). 2008a. Decision Memorandum on Action and for Application of Departmental Categorical Exclusion 1.12 (or 1.13 or both) East Sopris Fuels Reduction. CO-140-2008-029-CX. Decision Record signed February 21, 2008.

Bureau of Land Management (BLM). 2008b. Four Mile Fuels Reduction Project Environmental Assessment. CO-140-2009-0002. Decision Record signed October 8, 2008.

Bureau of Land Management (BLM). 2008c. Reasonable Foreseeable Development: Oil and Gas in the Glenwood Springs Field Office Administrative Boundary Area. BLM, Glenwood Springs Field Office and Colorado State Office, Colorado.

Bureau of Land Management (BLM). 2007. Reasonable Foreseeable Development Scenario for Oil and Gas Activities in the BLM White River Field Office: Rio Blanco, Moffat and Garfield Counties, Colorado. U.S. Department of the Interior, Bureau of Land Management, White River Field Office. September 10, 2007.

Colorado Department of Transportation (CDOT). 2015. Online Transportation Information System data catalog, accessed/downloaded 3/22/2015.

Colorado Oil and Gas Conservation Commission (COGCC). 2015. Colorado Oil and Gas Information System (COGIS). Available at: http://cogcc.state.co.us/COGIS/LiveQuery.html.

City of Glenwood Springs (Glenwood Springs). 2011. Glenwood Springs Comprehensive Plan 2011. Available at: http://cogs.us/departments/community/Forms/GlenwoodSpringsCompPlan2011.pdf.

Garfield County. 2013. Garfield County Comprehensive Plan 2030. Adopted: November 10, 2010, Last Amended: October 9, 2013. Available at: http://www.garfield-county.com/community-development/documents/Comprehensive-Plan-2030-10.09.2013.pdf.

Larson, G. 2015a. Personal communication between Greg Larson, BLM and Janet Guinn AECOM by email on May 21, 2015 regarding the status of the Uncle Bob Mountain Road Hazardous Fuels Treatment Project.

Larson, G. 2015b. Personal communication between Greg Larson, BLM and Janet Guinn AECOM by email on May 27, 2015 regarding the status of the Cedar Mountain Fuels Reduction Project.

Mesa County Mineral and Energy Resources Master Plan. 2011. February 2011. Available at: http://www.mesacounty.us/planning/energymasterplan.aspx.

Mesa County. 2013. Mesa Countywide Land Use Plan: From Issues to Action. October 1996; Updated February 2, 2006, Revised September 28, 2010, Revised February 24, 2011, Revised April 28, 2011, Revised May 23, 2013. .Available at: http://www.mesacounty.us/planning/master-plan.aspx.

Mesa County. 2014. Grand Valley 2040 Regional Transportation Plan Update. Prepared for the Mesa County Regional Transportation Planning Office by Cambridge Systematics, Inc. Available at: http://rtpo.mesacounty.us/template.aspx?id=14530&ekfxmensel=e5d7e86ea_1009_1010.

Pitkin County. 1987. Down Valley Comprehensive Plan. Prepared by the Aspen/Pitkin Planning Office. January 1987.

Pitkin County. 2003a. Pitkin County Comprehensive Plan. Available at: http://www.pitkincounty.com/224/Adopted-Master-Plans.

Pitkin County. 2003b. Crystal River Valley Master Plan. Available at: http://www.aspenpitkin.com/Portals/0/docs/county/Com%20Dev/Planning/Master_Plans/crystal_river_mp_plan.pdf.

Pitkin County. 2003c. Snowmass-Capitol Creek Valleys Master Plan. Available at: http://www.pitkincounty.com/860/Rural-Area-Plans.

Rio Blanco County. 2011. Rio Blanco County Master Plan. Prepared by Western Slope Consulting LLC and Central Mountain Planning LLC January 13, 2011. Available at: https://docs.google.com/file/d/0B8Frus39AJiHb0hycW9hY0Y0UTA/edit.

Ringer 2015. Personal communication between Sylvia Ringer, BLM and Janet Guinn AECOM by email on May 26, 2015 regarding the status of the Cedar Springs II Vegetation Treatment Project.

U.S. Department of Transportation Federal Highway Administration (USDOT). 2013. Highway Functional Classifications, Concepts, Criteria and Procedures, 2013 Edition. Available at: http://www.fhwa.dot.gov/planning/processes/statewide/related/highway_functional_classifications/fcauab.pdf.

U.S. Forest Service (USFS). undated. Fishing and Hiking— Battlement Reservoirs Information Sheet. Prepared by the United States Department of Agriculture, Forest Service, Rifle Ranger District.

U.S. Forest Service (USFS). 2015a. Grand Mesa, Uncompahgre and Gunnison National Forests Schedule of Proposed Action (SOPA). 01/01/2015 to 03/31/2015.

U.S. Forest Service (USFS). 2015b. White River National Forest Schedule of Proposed Action (SOPA), 04/01/2015 to 06/30/2015.

U.S. Forest Service (USFS). 2014a. White River National Forest Oil and Gas Leasing Final Environmental Impact Statement.

U.S. Forest Service (USFS). 2014b. Notice of Proposed Action Colorado Department of Transportation Colorado State Highway 133 Horseshoe Bend Fill Site and Placita Restoration. USDA Forest Service, Aspen and Sopris Ranger District, White River National Forest, September 24, 2014. Available at: http://a123.g.akamai.net/7/123/11558/abc123/forestservic.download.akamai.com/11558/www/nepa/46345_FSPLT3_2369685.pdf.

U.S. Forest Service (USFS). 2014c. South Rifle Habitat Enhancement Project Environmental Assessment. Rifle Ranger District White River National Forest Garfield and Mesa Counties, Colorado. July 2014.

U.S. Forest Service (USFS). 2014d. Grand Mesa, Uncompahgre & Gunnison (GMUGNF) National Forests Spruce Beetle Epidemic and Aspen Decline Management Response Project Questions and Answers November 2014.

U.S. Forest Service (USFS). 2013. Spruce Beetle Epidemic & Aspen Decline Management Response EIS, Grand Mesa, Uncompahgre, and Gunnison National Forests. Available at: http://westcolc.org/wp-content/uploads/2013/12/Spruce-Beetle-and-Aspen-Decline-Response-Project-Carmine-Lockwood.pdf.

U.S. Forest Service (USFS). 2010a. Reasonably Foreseeable Development Scenario for Oil and Gas Activities on the White River National Forest. White River National Forest, Colorado. September 2010.

U.S. Forest Service (USFS). 2010b Aspen-Sopris Wildlife Habitat Improvement Scoping Letter and Scoping Map.

U.S. Forest Service (USFS). 2007a. Decisions Record and Finding of no significant impact for the White River National Forest invasive Plant species management EA. Available at: http://a123.g.akamai.net/7/123/11558/abc123/forestservic.download.akamai.com/11558/www/nepa/18797_FSPLT2_032853.pdf.

U.S. Forest Service (USFS). 2007b. U.S. Forest Service Grand Mesa, Uncompahgre and Gunnison National Forests, Grand Valley Ranger District Hunter Reservoir Enlargement Draft Environmental Impact Statement. June 2007.

U.S. Forest Service (USFS). 2004. Oil and Gas Potential and Reasonable Foreseeable Development (RFD) Scenarios in the Grand Mesa, Uncompahgre, and Gunnison (GMUGNF) National Forests Colorado. Prepared by Bruce Fowler and Pat Gallagher (Bureau of Land Management), August 27, 2004.

This page intentionally left blank

Appendix C

Socioeconomics Technical Appendix

This page intentionally left blank

Socioeconomics Technical Appendix

This technical appendix describes the methodology, key data and assumptions used for the socioeconomic impact analysis for the EIS. The appendix first discusses the impact analysis approach from the new natural gas well construction and their subsequent long-term operations. The appendix also shows the approach used to estimate the related revenue impacts on the county governments and region's economy from the wells' future natural gas production. The potential for related economic impacts on also is addressed in this Technical Appendix.

The technical appendix also describes the methodology, key data and assumptions used for the IMPLAN analysis used to estimate the direct, indirect and induced impacts on the region's economy from the spending and revenue impacts of the future new well construction, their operations and their revenue impacts on the county governments. Analysis results for Alternative 1 are included in the discussion to assist in explaining the analysis approach. Well construction and future natural gas production are based on the project assumptions discussed in Section 2.2.7.

Unless stated otherwise, the analysis is performed in 2014 dollars. It is assumed that full development of the leases will occur over the 20-year time period of 2017 to 2036.

New Well Construction and Production Operations

Projecting future natural gas construction activity and subsequent production levels are central to the evaluation of the EIS alternatives future socioeconomic impacts. County level analysis of the EIS Alternatives impacts requires identification of the future natural gas development activity on a county basis.

The following sections discuss the socioeconomic analysis's key components. The approach and key assumptions used for the socioeconomic analysis also are presented below.

Existing Well Operations

There are 75 existing directional wells currently in production. Under Alternatives 1 through 4 these wells are expected to continue to operate for the rest of their useful operating life. Since the existing well production is part of the existing conditions for the Alternative 1 (No Action), only new well production is analyzed in the socioeconomic impact analysis for Alternatives1 through 4.

Consequently, existing well production is only evaluated under Alternative 5, which would cancel all well leases and close all 75 existing wells. Under Alternative 5, the existing wells closure would result in a direct economic loss from the future natural production from the 75 existing wells.

These wells began producing between 2002 and 2012. For the purposes of the socioeconomic impact analysis the wells are conservatively assumed to have the weighted average start date of 2007. As these wells are anticipated to have a 20-year production lifespan, they are expected, on average, to continue production through 2026. The total estimated annual future production of the 75 wells is estimated to be 4.5 billion cubic feet (Bcf).

Future Well Development Locations

The specific locations of the future well development sites will be selected by the lessee are therefore currently unknown. Therefore, the socioeconomic analysis allocated future well locations based on the proportion of each lease's developable acreage within each county. For example, if 20 percent of a lessee's land is located in Pitkin County, the analysis attributed 20 percent of that leases' future well development sites to Pitkin County.

In cases where a parcel is predominantly (i.e., 90 percent or more) within a single county, all future well development has been attributed to that county. Additionally, 116 leased acres are located in Gunnison County. However, since none of the individual leases have more than 7 percent of its acreage within Gunnison County, for purposes of the socioeconomic analysis it is assumed that no drilling would occur in Gunnison County.

New Well Construction

The socioeconomic analysis assumes all wells will be viable as long-term production wells. It also is assumed that future well development will occur at a constant rate over the 20-year analysis period. For example, under Alternative 1, a total of 416 wells would be developed over the future 20-year analysis period. Therefore, approximately 21 new wells will be constructed each year between 2017 and 2036. **Table C-1** shows Alternative 1 future new well construction, producing wells and their total natural gas production on an annual basis.

Table C-1 Well Count and Natural Gas Production (2017-2036) - Alternative 1

Year	New Directional Wells	New Horizontal Wells	Producing Directional Wells	Producing Horizontal Wells	Natural Gas Production (Bcf)
2017	19.9	0.9	19.9	0.9	1.5
2018	19.9	0.9	39.8	1.8	3.0
2019	19.9	0.9	59.8	2.7	4.4
2020	19.9	0.9	79.7	3.6	5.9
2021	19.9	0.9	99.6	4.5	7.4
2022	19.9	0.9	119.5	5.4	8.9
2023	19.9	0.9	139.4	6.3	10.4
2024	19.9	0.9	159.4	7.2	11.9
2025	19.9	0.9	179.3	8.1	13.3
2026	19.9	0.9	199.2	9.0	14.8
2027	19.9	0.9	219.1	9.9	16.3
2028	19.9	0.9	239.0	10.8	17.8
2029	19.9	0.9	259.0	11.7	19.3
2030	19.9	0.9	278.9	12.6	20.8
2031	19.9	0.9	298.8	13.5	22.2
2032	19.9	0.9	318.7	14.4	23.7
2033	19.9	0.9	338.6	15.3	25.2
2034	19.9	0.9	358.6	16.2	26.7
2035	19.9	0.9	378.5	17.1	28.2
2036	19.9	0.9	398.4	18.0	29.7
Total	398.4	18.0	398.4	18.0	311.5
Average	19.9	0.9	209.2	9.5	15.6

The future new well development under Alternative 2 would be very similar to that under Alternative 1. Slightly fewer new wells would be constructed under Alternatives 3 and 4. No new well construction would occur under Alternative 5.

Future Total Natural Gas Projection

Directional and horizontal wells are expected to produce 1.2 Bcf and 6.4 Bcf of natural gas, respectively, over their 20-year operational lifespans. The wells are expected to operate at a steady production rate. As a result, each directional well is expected to produce 60 million cubic feet of natural gas annually. Each horizontal well is expected to produce 320 million cubic feet of natural gas annually.

Table C-2 shows the projected total natural gas production for the region and on a county basis by alternative. These values represent the total production over the 20-year analysis period by calculating the number of production wells operating each year (see **Table C-1** above for Alternative 1) and multiplying them by their respective annual production rate.

Table C-2 Natural Gas Production by County (2017-2036)

	Natural Gas Production (Bcf) (2017-36)				
Location	**Alt 1**	**Alt 2**	**Alt 3**	**Alt 4**	**Alt 5**
Four-county Region	311.5	311.5	309.6	288.9	-45.0
Garfield	85.1	85.1	87.8	81.8	-8.6
Mesa	203.9	203.9	199.6	199.7	-35.4
Pitkin	16.2	16.2	15.9	0.7	0.0
Rio Blanco	6.3	6.3	6.3	6.3	0.0

Estimated Average Cost of Natural Gas Development and Production

Well Construction

Development of a typical directional natural gas well is expected to employ 55 direct workers working 12-hour shifts for an average of 11 days (BBC Research 2014). This corresponds to a total of 3.5 full time equivalents (FTEs) for 1 year (or job-year) assuming 8-hour shifts. The total cost of new well construction (including all necessary labor, equipment and materials) is estimated to be approximately $1.8 million (BBC Research 2014).

Construction of a new horizontal well is estimated to take three times as long as a directional well, and therefore is expected to cost approximately three times as much to develop (WPX 2014). Therefore, construction of a new horizontal well is estimated to be $5.5 million and expected to require a total of 10.5 job-years of labor.

Note that while the proposed stipulations may reduce the extent of some leases future development, no major additional development costs are expected to be associated with complying with the proposed stipulations and/or the well-site relocations.

Road Construction

Wells may be located in remote areas that will require new road construction for the well to be developed. Other wells may be located near existing roads and therefore would require little in the way of new road construction for site access. For the socioeconomic impact analysis it is estimated that on average one mile of new road construction will be required for each new well pad development and that each well pad can support an average of seven wells (WRNF 2010). Consequently, on average each new well will require 0.14 mile of new road construction.

Road construction cost estimates for the region vary greatly. The Corridor Analysis Report performed for the East Divide Access Route in Pitkin County determined that a previously county maintained gravel road might be upgraded for $21,000 per mile. The upgrade cost for a minimally maintained natural surface road could cost between $429,000 and $2.5 million per mile, depending on the grade, horizontal alignment and other issues (SGM 2012).

For the socioeconomic analysis the average cost of future road construction within the WRNF is estimated to be $1.1 million per mile for minimally maintained natural surfaces. Therefore each well would require an average of $157,000 of road construction. Each $92,000 of labor construction spending is expected to generate 0.64 job-years of direct and indirect labor (ARRA 2009). It also is estimated that 40 percent of the road construction cost will be for labor. As a result road construction for each well is expected to require $63,000 in labor spending which would create 0.4 direct and indirect jobs.

Natural Gas Production Operations and Maintenance Cost

Once well construction is complete employees will be required to both operate and maintain the wells during their 20-year production lifespan. Recent analysis has estimated that 1,000 directional producing wells will have a total annual operating cost of $35 million and require 200 FTEs of labor (BBC Research 2014). A horizontal well produces more than five times as much natural gas as a directional well and costs three times as much to construction. Therefore, the socioeconomic analysis averaged the two values for an operating cost factor of four times the operating cost for a directional well. Based on this assumption, 1,000 horizontal producing wells are expected to have an annual operating cost of $140 million and require 800 FTEs. This direct employment estimate includes not only the required onsite labor but also the necessary management and support.

This translates to 0.2 FTEs per directional well and 0.8 FTEs per horizontal well. About 70 percent of these jobs are directly related to the on-site natural gas production with the remaining 30 percent associated with management, support and downstream activities.

Total Natural Gas New Construction, Operating, and Production Cost and Employment

Table C-3 shows the total well construction and operating costs for Alternative 1. The projected direct employment also is shown. These cost estimates are used by the IMPLAN analysis to estimate indirect and induced employment and economic output impacts to the regional economy.

Future Government Revenues from Natural Gas Activity

Government revenues generated from oil and gas activities that occur within its jurisdiction will depend on well production quantities. For counties with significant oil and gas extraction activity, oil- and gas-related tax revenue can represent a major percentage of general fund expenses. In 2012 Garfield County received oil and gas related revenues equal to approximately 35 percent of its general fund expenses (Garfield County 2012).

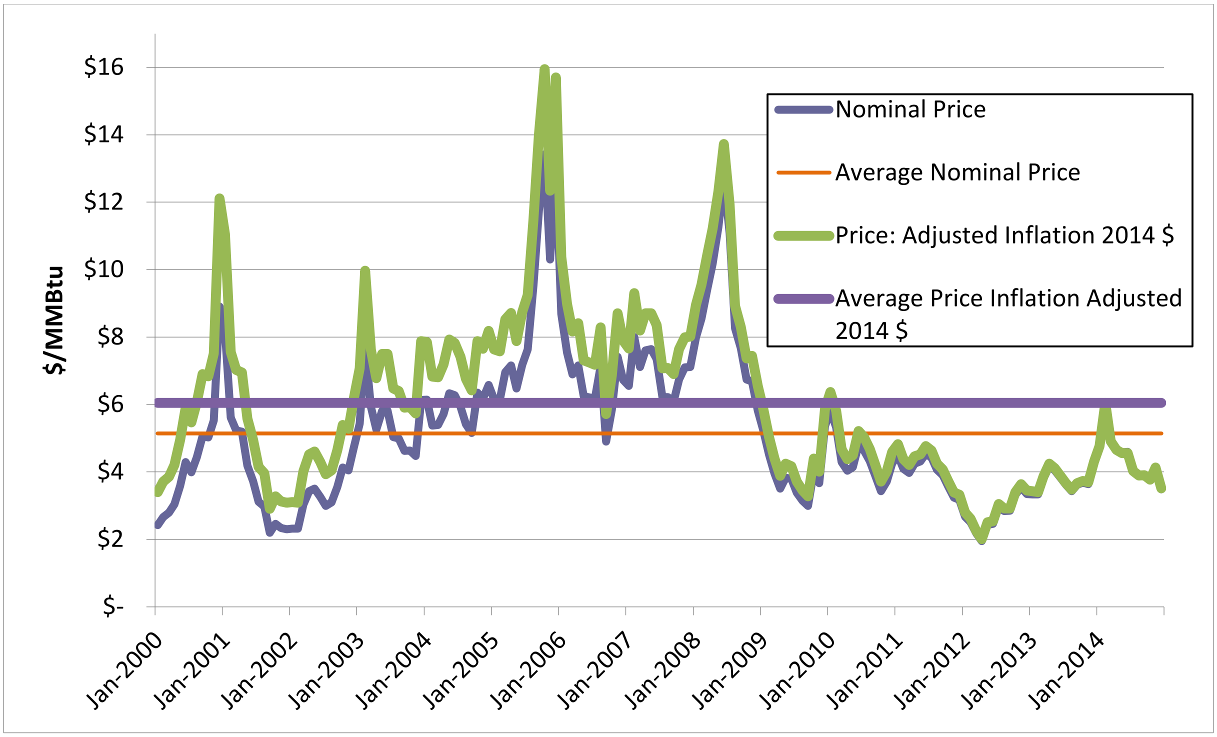
Table C-3 Future Construction and Operating Costs and Employment (2017-2036) - Alternative 1 ($ Millions)

Year	New Well Development Cost				Production Cost				Total Cost	
	Well Construction		Road Construction		Operations		Support			
	Costs	Employment	Costs	Employment	Costs	Employment	Costs	Employment	Costs	Employment
2017	$41.7	79.0	$3.3	9.2	$0.6	3.3	$0.2	1.4	$45.8	92.9
2018	$41.7	79.0	$3.3	9.2	$1.2	6.6	$0.5	2.8	$46.6	97.6
2019	$41.7	79.0	$3.3	9.2	$1.7	9.9	$0.7	4.2	$47.4	102.3
2020	$41.7	79.0	$3.3	9.2	$2.3	13.2	$1.0	5.6	$48.2	107.0
2021	$41.7	79.0	$3.3	9.2	$2.9	16.5	$1.2	7.0	$49.1	111.7
2022	$41.7	79.0	$3.3	9.2	$3.5	19.8	$1.5	8.4	$49.9	116.4
2023	$41.7	79.0	$3.3	9.2	$4.0	23.1	$1.7	9.8	$50.7	121.1
2024	$41.7	79.0	$3.3	9.2	$4.6	26.4	$2.0	11.2	$51.5	125.8
2025	$41.7	79.0	$3.3	9.2	$5.2	29.7	$2.2	12.6	$52.3	130.5
2026	$41.7	79.0	$3.3	9.2	$5.8	33.0	$2.5	14.0	$53.2	135.2
2027	$41.7	79.0	$3.3	9.2	$6.4	36.3	$2.7	15.4	$54.0	139.9
2028	$41.7	79.0	$3.3	9.2	$6.9	39.6	$2.9	16.8	$54.8	144.6
2029	$41.7	79.0	$3.3	9.2	$7.5	42.9	$3.2	18.2	$55.6	149.3
2030	$41.7	79.0	$3.3	9.2	$8.1	46.2	$3.4	19.6	$56.5	154.0
2031	$41.7	79.0	$3.3	9.2	$8.7	49.5	$3.7	21.0	$57.3	158.7
2032	$41.7	79.0	$3.3	9.2	$9.2	52.8	$3.9	22.4	$58.1	163.4
2033	$41.7	79.0	$3.3	9.2	$9.8	56.1	$4.2	23.9	$58.9	168.1
2034	$41.7	79.0	$3.3	9.2	$10.4	59.4	$4.4	25.3	$59.8	172.8
2035	$41.7	79.0	$3.3	9.2	$11.0	62.7	$4.7	26.7	$60.6	177.5
2036	$41.7	79.0	$3.3	9.2	$11.6	66.0	$4.9	28.1	$61.4	182.3
Total (2017-2036)	$833.3	1,579.1	$65.4	184.4	$23.1	693.2	$9.8	294.6	$1,071.6	2,751.3
Annual Average	$41.7	79.0	$3.3	9.2	$23.7	34.7	$10.1	14.7	$53.6	137.6

County revenues from natural gas production are expected to support existing job positions and potentially add new jobs. The socioeconomic analysis conservatively assumes that 50 percent of the future new natural gas revenues may be saved in an “Oil and Gas Mitigation Fund” or an “Emergency Reserve Fund.” In which case, during most years when these funds are held in reserve, these contingency funds will have no spending impact on the regional economy. County governments are expected to predominantly use the remaining revenues for capital expenditures (7.5 percent on road construction; 12.5 percent on public building maintenance and repair; and 15 percent on other local government activities (e.g., community development, airports and water). Only 15 percent of the natural gas revenues are expected to be used to pay county government staff salaries.

Natural Gas Prices

As seen in **Figure C-1**, there has been significant volatility in natural gas prices nationally since 2000. As a result of nationwide production increases and other factors, natural gas prices peaked at nearly $13/MMbtu in 2008. However, since then natural gas prices have decreased dramatically (EIA 2015). Between 2000 and 2014, the Henry Hub average nominal natural gas price was $5.14/MMBtu. Adjusted for inflation, between 2000 and 2014 natural gas prices averaged approximately $6.05 in 2014 dollars (U.S. Inflation Calculator 2015).



Source: EIA 2014.

Figure C-1 Henry Hub Natural Gas Prices

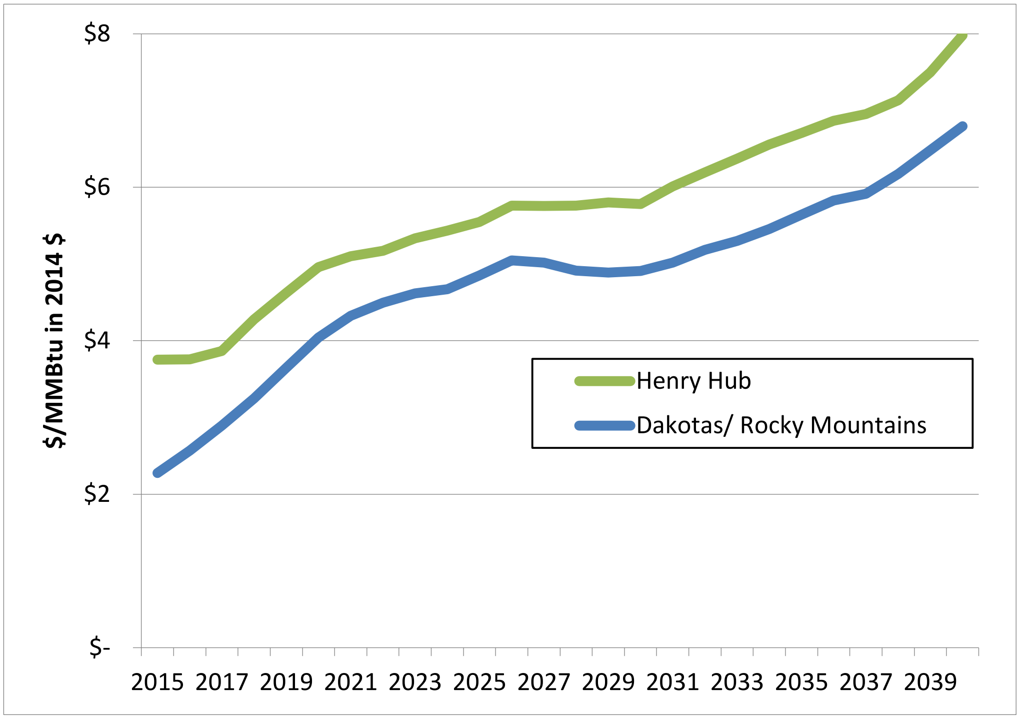
Past Colorado wellhead prices have not consistently correlated with Henry Hub prices due primarily to fluctuations in both natural gas supply conditions and transportation costs. The Leeds 2013 report (citing the Colorado Geological Survey) reported an average of price of $2.87 per thousand cubic feet (Mcf) in Colorado in 2012, with oil priced at $87.33 per barrel, and CO_2 at $0.86 per Mcf. These values were used for the total sales revenue estimates shown in **Table C-4**.

Table C-4 Natural Gas Sales (2012) ($ Millions)

Area	Natural Gas Sales	Oil Sales	CO_2 Sales	Total Sales	Natural Gas Sales (%)
Colorado	$4,764.5	$4,252.3	$377.5	$9,394.3	51
Four-county Region	$2,384.6	$673.7	$0	$3,058.3	78
Garfield County	$1,987.7	$245.0	$0	$2,232.6	89
Mesa County	$129.4	$5.6	$0	$135.0	96
Pitkin County	$0	$0	$0	$0	0
Rio Blanco County	$267.5	$423.1	$0	$690.7	39

Source: Leeds 2013.

Recent expansion of Colorado's natural gas pipeline system has resulted in greater consistency with Henry Hub prices. However, Colorado's natural gas prices are expected to continue to vary in the future (EIA 2015). As shown in **Figure C-2**, natural gas prices in the Dakotas/Rocky Mountains are forecasted to increase in real terms through 2040 with a projected average price between 2017 and 2036 of $4.70/MMBtu in 2014 dollars (EIA 2014).



Source: EIA 2014.

Figure C-2 EIA Natural Gas Price Projections (2015-2040)

Table C-5 shows the inflation adjusted projected future price for natural gas based on U.S. Department of Energy Information Administration projections for the Dakotas/Rocky Mountains region (EIA 2014).

Table C-5 Future Natural Gas Price Projections in Rocky Mountains ($2014)

Year	Natural Gas Price $/Mcf [1]
2017	$2.61
2018	$2.28
2019	$2.57
2020	$2.89
2021	$3.25
2022	$3.65
2023	$4.04
2024	$4.32
2025	$4.50
2026	$4.62
2027	$4.67
2028	$4.85
2029	$5.05
2030	$5.02
2031	$4.91
2032	$4.89
2033	$4.91
2034	$5.02
2035	$5.18
2036	$5.30

[1] Future price projections adjusted for inflation from 2013 to 2014 values by 1.62%.using the CPI-U.

Source: EIA 2014.

As new natural gas wells are constructed each year over the 20-year time period, natural gas production from the leases is projected to increases substantially and consequently natural gas revenue payments to the region's County governments also will be expected to increase.

Table C-6 projects the sales value of Alternative 1 total future natural gas production on annual basis over the 20-year analysis period. The annual sales revenue estimates are based on the expected schedule of well construction (**Table C-3**), well production assumptions (60 and 320 Mcf/yr of natural gas for directional and horizontal wells, respectively), and future expected natural gas price prices (**Table C-5**).

Table C-7 shows the projected value of total future natural gas production under Alternative 1 for each county in the region. Under all the alternatives, the majority of the future natural gas production (or loss) would occur from natural gas development in Mesa County.

Table C-6 Projected Natural Gas Production and Revenues (2017-36) - Alternative 1

Year	Natural Gas Production (Bcf)	Natural Gas Sales ($ Millions)
2017	1.5	4.3
2018	3.0	9.6
2019	4.4	16.2
2020	5.9	24.0
2021	7.4	32.1
2022	8.9	40.0
2023	10.4	47.9
2024	11.9	55.4
2025	13.3	64.7
2026	14.8	74.9
2027	16.3	81.9
2028	17.8	87.4
2029	19.3	94.2
2030	20.8	101.9
2031	22.2	111.6
2032	23.7	123.0
2033	25.2	133.7
2034	26.7	145.6
2035	28.2	159.1
2036	29.7	172.9
Total	311.5	1,580.4
Average Annual (2017-36)	15.6	79.0

Table C-7 Total Future Natural Gas Sales by County (2017-2036)

	Total Natural Gas Sales (2017-36)				
Location	**Alt 1**	**Alt 2**	**Alt 3**	**Alt 4**	**Alt 5**
Four-county Region	$1,580.4	$1,580.8	$1,570.9	$1,465.7	-$183.4
Garfield	$431.6	$431.9	$445.5	$415.3	-$35.3
Mesa	$1,034.8	$1,034.8	$1,012.6	$1,013.2	-$148.1
Pitkin	$82.2	$82.2	$80.8	$3.5	$0
Rio Blanco	$32.0	$32.0	$32.0	$32.0	$0

Note: Total may not sum exactly due to rounding.

Federal Mineral Lease Revenues

The Federal Government collects royalties, rents and bonus payments from non-renewable resource production occurring on federal lands. Together these fees and royalties constitute the federal mineral lease (FML) revenues paid to the federal government for mineral extraction on federal lands. Total FML payments statewide in Colorado are typically equal to approximately 12.5 percent of the mineral production value.

Nearly half (49 percent) of these revenues are redistributed to the state from where the mineral leases production occurred, which is equivalent to 6.13 percent of the mineral production value. Colorado retains the majority of these revenues (60 percent) and distributes the remaining 40 percent to its county and local governments either through direct distributions (20 percent of the state FML revenues) or through its grant assistance program (20 percent of the state FML revenues). Together these distributions equates to 2.45 percent of the total value of production. The direct distribution is based upon where the resource was extracted.

Table C-8 provides the 2012 revenues that both the region and each individual county directly received from the Federal Mineral Leasing Program for both oil and gas. The estimated total distribution to local municipalities and school districts also are shown.

Table C-8 Federal Mineral Lease Revenues for Four County Region (2012)

Area	FML Revenues ($ Millions)
Colorado	72.4
Four County Region	8.8
Garfield County	3.8
Mesa County	1.9
Pitkin County	0.0
Rio Blanco County	3.1
Local Communities [1]	3.5

[1] Includes nearby school and special districts as well as the communities of Parachute, Rifle, Silt, New Castle, Glenwood Springs, Carbondale, and De Beque. Local communities FML revenues are included within county totals.

Source: Leeds 2014.

This analysis assumed that future FML revenues for the region's counties and local communities would continue to be 2.45 percent of total natural gas sales value. For the purposes of the analysis, the economic impacts to local governments are recognized and aggregated at the county level. The socioeconomic analysis primarily focuses on the county government revenues changes. Due the number and complexity of the sub-county jurisdictions, the specific revenue impacts to smaller municipalities are not estimated.

Property Taxes

The counties assess annual property taxes on three separate types of properties (land, improvements, and the extracted minerals). The federal government does not pay any county or city property taxes on the land they own and improvements they construct. Instead the federal government generally pays "Payments in Lieu of Taxes" (PILT) to local governments to help offset their losses in property taxes. Future PILT are not expected to changes as a result of future well development and therefore are not further analyzed.

However, local counties and cities obtain property tax revenue from non-federal improvements and the minerals extracted on these lands (Sean McCourt 2015). The counties collect these property taxes on behalf of the local agencies based on mill levies set by the counties, cities, towns, special districts and school districts and then distributes them according to the agencies. **Table C-9** shows the total natural gas related properties tax revenues received in 2012 by the region's counties and local communities. The average property tax percentages on natural gas production also were estimated based on its corresponding natural gas production values. These values were estimated based on the percentage of natural gas sales to total mineral extraction revenues.

Table C-9 Estimated Property Tax Rates (2012)

Area	Property Tax on Natural Gas Production ($ Millions)	Production Value Percentage
Four County Region (ex. local agencies) [1]	43.7	1.84
Garfield County	34.5	1.74
Mesa County	6.3	4.89
Pitkin County [2]	0	1.10
Rio Blanco County	2.9	1.10
Local Communities [3]	49.9	0.93

[1] Regional total only includes county governments.

[2] Pitkin County currently has no natural gas production. Pitkin's future property tax rate is assumed to be the same as Rio Blanco County.

[3] Includes nearby school and special districts as well as all cities and towns in the region. However, cities and towns accounted for only $105,000 combined.

Source: Leeds 2014.

Severance Tax

In 2012, 71 percent of Colorado's natural gas sales were taxed for severance compared with only 19 percent of the state's oil production. As a result, natural gas production generated 81 percent of the state's total severance tax revenues. These values were used to determine the amount of severance produced by natural gas and compared it to natural gas sales in the state. If a particular well development is assessed a property tax levy greater than 58 mills, then it will incur no severance tax (consequently wells in Mesa County are expected to result in no future severance tax revenues).

Colorado distributes fifty percent of its collected severance tax revenues through its local impact fund. The local impact fund distributes thirty percent (or 15 percent of total severance tax revenues) directly to county and local agencies and the other 70 percent (or 25 percent of total severance tax revenues) are distributed as competitively awarded grant projects.

A county may receive severance tax revenues even if wells in the county did not generate any severance tax revenue. **Table C-10** shows the estimated natural gas severance taxes directly distributed to each county as well as local communities. In addition, severance tax also funds a state-wide grant program. Allocation is determined for specific projects basis on both need and on a competitive basis. Consequently, the extent that any future severance tax revenue increases from the Alternatives will result in increased grant program awards for the local communities cannot be projected. Therefore, only direct distribution severance revenues are attributed by the socioeconomic analysis.

Table C-10 Estimated Severance Tax Revenues and Rates (2012)

Area	Severance Tax Direct Distribution from Natural Gas Production	Production Value Percentage
Colorado	$60.7	1.80
Four County Region [1]	$3.7	0.11
Garfield County	$1.7	0.05
Mesa County	$1.5	0.04
Pitkin County	$0.0	0.01
Rio Blanco County	$0.5	0.01
Local Communities [2]	$1.3	0.04

[1] Regional total only includes county governments.

[2] Includes nearby school and special districts as well as the communities of Parachute, Rifle, Silt, New Castle, Glenwood Springs, Carbondale and De Beque.

Source: Leeds 2014.

Table C-10 shows the calculated percentages to be used in the analysis based on natural gas sales in Garfield, Pitkin and Rio Blanco Counties. The estimated total severance tax revenues distributed to local municipalities and school districts also are shown. Although the analysis did not include the estimated future local severance tax revenues in its IMPLAN analysis estimating the indirect and induced economic impacts, if these revenues are obtained in the future they may be expected to result in induced and indirect of a similar type and proportional magnitude as those determined for the county severance tax revenues.

Colorado Oil and Gas Conservation Commission (COGCC) Taxes

Oil and gas companies are required to pay COGCC a conservation levy (currently 0.07 percent of sales less qualified exemptions) for commission expenses and to contribute to its Environmental Response fund. COGCC tax revenues in 2012 were $4.7 million and down from $7.1 Million in 2011 (Leeds 2013). However these revenues do not directly impact the county or local governments and were therefore are not considered further in the socioeconomic analysis.

Total County Governmental Revenues from Natural Gas Production

The future natural gas related revenue from future development of the EIS alternatives are estimated based on the estimated future natural gas production increases (shown in **Table C-1** and **C-2**) and the tax specific average percentage rates. Over the 20-year study period, the combined total of all natural gas related revenues are expected to result in an estimated $98.8 million in additional revenues for the local governments within the Four County Region. **Table C-11** shows the future total tax revenues for each county based on the estimated future sales from the natural gas operations.

Cancelation of Existing Leases

Some or all of the leases may be canceled at the BLM's or by the lessee request as a result of the new stipulations. Cancellation would occur through a BLM administrative process and in many cases may potentially require that the lessee is refunded its previous bonus bids and lease payments. Should the lessee not accept the new lease stipulations on a producing lease, it may be necessary for the BLM to request judicial action to cancel the lease. The federal government will only be responsible for repayment of the federal share of the refund to the lessee. The State of Colorado and the county and local municipalities would be liable for repayment of the remaining non-federal share (49 percent). While it is possible that the local municipalities might have to pay for the portion of the revenue they received directly (estimated to be 40 percent of the non-federal total), in the recent case of the Roan lease closures, the State of Colorado assumed sole responsibility for repayment of the non-federal share of any necessary bonus bid and lease payment refunds.

Table C-11 Total Projected Natural Gas Revenues for Counties (2017-36) - Alternative 1 ($ Millions)

Area	Total Natural Gas Revenues	FML Revenues	Property Taxes	Severance
Four County Region [1]	$98.8	$38.7	$59.4	$0.7
Garfield County	$18.4	$10.6	$7.5	$0.3
Mesa County	$76.2	$25.4	$50.6	$0.2
Pitkin County	$3.0	$2.0	$0.9	$0.1
Rio Blanco County	$1.2	$0.8	$0.4	$0.1
Local Communities [2]	$14.9	$0.0	$14.7	$0.2

[1] Regional total only includes county governments.

[2] Includes nearby school and special districts as well as the communities of Parachute, Rifle, Silt, New Castle, Glenwood Springs, Carbondale, and De Beque. FML revenues are accounted for at the county level.

If an Alternative (e.g., Alternative 4) cancels part of a lease, the BLM would refund any bonus bids and lease payments associated with the specific acreage loss. Each lease pad typically requires at most 10 acres of developable area. Depending on the stipulations and site conditions, a specific lease location may not be to support development of a lease pad. Therefore, as a conservative assumption, all leases with less than 100 acres of remaining unencumbered land areas are assumed to be completely canceled and all of its bonus bids and lease payments will be refunded.

Alternatives 2, 3, and 4 are expected to result in some future reductions (compared to Alternative 1) in the natural gas production of some of their lease parcels. However, the reductions are expected to be relatively limited and it is assumed that no refunds payments by BLM would be required.

IMPLAN Analysis

IMpact Analysis for PLANning (IMPLAN) is the Input-Output model used to evaluate economic effects of each EIS Alternative. The IMPLAN model was originally developed by the U.S. Department of Agriculture Forest Service to assist in land and resource management planning, but its role has expanded to serve clients in federal, state, and local governments, universities, as well as the private sector. IMPLAN is an accepted and widely used regional economic modeling tool that can measure the effect of projects or policies on local economic conditions. The IMPLAN model can estimate changes in regional output, income, value added, and employment. Accordingly, the model is used to estimate regional output and employment effects, which are the focus of this analysis.

IMPLAN provides estimates of direct, indirect and induced economic impacts based on future changes in spending with the region. IMPLAN can analyze both the initial spending change (i.e., direct spending) and its subsequent indirect economic effects resulting from income transfers to supplier businesses and induced economic effects from employee (of both the direct and supplier business's) spending of their wages.

IMPLAN also can estimate the economic impacts on a sector by sector basis so that the magnitude of employment and output changes can be estimate not only on total overall countywide (or regional) basis but also for a specific business sector (or set of sectors). IMPLAN generally can analyze up to

536 sectors – although in many cases, and particularly in more rural counties, many business sectors may not be active in the economy.

Output represents the value of industry production. In IMPLAN these are annual production estimates expressed in producer prices. For manufacturers this would be sales plus/minus change in inventory. For service sectors production output is represented by sales. For retail and wholesale trade, output corresponds to gross margin (i.e., net of the goods' input cost) and not gross sales.

The 2013 IMPLAN dataset for Garfield, Mesa, Pitkin, and Rio Blanco counties were used to develop both the combined regional-level and individual County models used by the socioeconomic analysis to estimate the direct, indirect and induced impacts from the projected spending future changes under the EIS Alternatives. IMPLAN is an annual model and therefore all model inputs were converted into average annual values (undiscounted) based on a straight-line extrapolation of the future spending effects between 2017 and 2036. In addition, all effect estimates have been normalized into 2014 dollar terms so that no price (i.e., inflation) effects are reflected in the economic or cost impact calculations. In the case of this analysis, the direct impacts calculated by IMPLAN were not utilized in the final estimation of employment and economic activity impacts. These impacts were based off of research conducted by BBC that provided locally estimated employment, construction and operation costs of the oil wells. It was felt that these estimates provided a better approximation of the direct impacts of the well construction and natural gas production.

Overall spending is expected to occur in four separate industries. Construction is expected to occur in both the “37-Drilling Oil and Gas Wells” and “56-Construction of New Highways and Streets” industries with employment and spending expected to remain constant through the analysis period. Production is expected to occur in “21-Extraction of Natural Gas Liquids” and “38-Support Activities for Oil and Gas Operations” industries, and is expected to gradually increase as more wells begin to produce.

Well Construction and Natural Gas Production

Future well and road construction will result in substantial capital spending. Construction costs will include payments to construction labor, as well as procurement of construction-related goods and services. Similarly, the subsequent developed wells will incur annual operating and maintenance (O&M) costs associated with their natural gas production that also will add new economic activity to the region's economy.

The regional economic effects from well and road construction will be temporary, coinciding with the construction period. Future lease development and well construction activity could vary over the 20-year timeframe. However, for this analysis, future well and road construction activity have been allocated proportionately over the 20-year period in order to provide estimates of average annual economic effects attributed to well construction for future lease development under each EIS Alternative. Future O&M spending will increase in the region as the newly constructed wells begin steady production.

To the extent that this construction and operations spending occurs locally, future lease development will generate regional economic effects. However, based on the relatively small size of the local counties' economies and the specialized nature of many of the construction inputs, it is anticipated that substantial portion of the well construction expenditures would be for equipment and materials that would need to be imported into the region. In which cases, the portion of the construction spending for wells would have less of an economic effect on local and regional economies than if they were larger economies that were able to supply a higher percentage of the required equipment and materials.

The IMPLAN analysis evaluates payments to labor separately from spending on equipment and materials. The IMPLAN analysis allocated total construction spending across these three expense categories: labor (20 percent for well construction and 40 percent for road construction); equipment

(40 percent for well construction and 30 percent for road construction) and materials (including input services) (40 percent for well construction and 30 percent for road construction). For operations spending, it was assumed that labor cost would account for the majority (60 percent) of the annual production related cost with the remainder split evenly between equipment (20 percent), and materials (20 percent).

Labor Sourcing

As a result of the region's past history of natural gas development and its current labor supply conditions, future construction labor sourcing for wells is assumed to be an 80 percent labor local resident and 20 percent non-local employment. Non-local workers would likely consist of both specialized skill employees and less skilled general laborers that would be needed for specific tasks or on a short-notice/short-term basis (BLM 2015). For road construction it is expected that all employment needs would be met locally. Future labor needs for the operations of the producing wells are expected to be possible by employing local residents.

Some of these workers (especially the more skilled workers) may be interested and willing to relocate to the area - particularly given the federal leases' 20-year development rights. If the actual proportion of transient workers is less than the 20 percent assumed by the impact analysis, the magnitude of the direct, indirect, and induced effects may be expected to be proportionally increased as a greater portion of the project's labor expenditures would instead be spent within the region.

For the purposes of the socioeconomic analysis of the potential population growth-related impacts (e.g., housing and public services demand) it is assumed that all non-local workers might represent the development-related transient labor attracted to the region. However, given the projected steady long-term construction that might encourage the transient workers permanent relocation to the region, the regional labor income effect was based on the full total construction labor spending.[1] These labor payments are modeled in IMPLAN as a labor income change (5001-Employee Compensation).

Equipment and Materials Sourcing

The IMPLAN analysis also noted the extent to which purchases of major equipment would likely need to be imported from outside the region. For other equipment and materials, the extent to which spending would occur in the local area is based on trade data in the IMPLAN model.

Only a minor proportion (10 percent) of the well development-related equipment or material purchases are expected to originate within the region. The majority of the local economic effect will likely result from in region value added from assembly or final manufacturing of equipment and materials. On-site consumption of natural gas would also account for a major proportion of development-related construction spending in the region. Consequently, a 10/90 local/non-local purchasing ratio for both well equipment and wells materials is conservatively assumed to ensure that the economic impacts to the regional from future well construction are not overestimated (BLM 2015).

Impact Findings

The above spending change estimates and cost factors were incorporated into the four county regional IMPLAN model. The socioeconomic impact analysis also modeled and analyzed each county individually The results below are a combination of the direct employment impacts based on the BBC Research estimates and the IMPLAN estimated indirect and induced impacts. The IMPLAN estimated jobs were converted into FTE (or job-year) terms using a sector-based conversion factor. The combined four county region results are slightly higher the sum of the four counties modeled individually as the combined four county region model also includes the spending transactions between the counties.

---

[1] A limited portion of the labor cost may consist of wages to staff working off-site (e.g., upper managers, accounting and other support staff) and located outside the region. However, no adjustment was made to the construction labor income since their proportion is unknown and expected to be minor compared to the on-site employment.

Tables C-12 to **C-14** shows the expected labor impacts from the projected future well construction and natural gas production operations for the Alternatives 1, 4, and 5.

Table C-12 Total Employment and Revenue Impacts Generated from Natural Gas Development and Operation (2017-36) - Alternative 1 ($ Millions)

Impact Type	County				Four County Region
	Garfield	Mesa	Pitkin	Rio Blanco	
Employment (Job-years)					
Direct	814.0	1,721.0	155.0	60.0	2,751.0
Indirect	118.8	345.1	9.3	9.6	592.8
Induced	260.0	884.0	29.6	9.6	1,240.2
Total (2017-36)	1,192.8	2,950.1	193.9	79.2	4,584.0
Income (Millions $)					
Labor Income	$83.1	$192.8	$16.4	$5.6	$309.1
Value Added	$49.9	$139.2	$7.4	$3.0	$217.4
Output	$277.8	$642.5	$42.7	$19.6	$1,021.3

Source: BBC 2012; IMPLAN 2015.

Table C-13 Total Employment and Revenue Impacts Generated from Natural Gas Development and Operation (2017-36) - Alternative 4 ($ Millions)

Impact Type	County				Four County Region
	Garfield	Mesa	Pitkin	Rio Blanco	
Employment (Job-years)					
Direct	776.0	1,698.0	7.0	60.0	2,542.0
Indirect	113.3	362.1	0.4	9.6	547.7
Induced	247.5	716.7	9.3	9.6	1,145.8
Total (2017-36)	1,136.8	2,776.9	16.7	79.2	4,235.5
Income (Millions $)					
Labor Income	$79.1	$190.2	$1.1	$5.6	$285.6
Value Added	$47.5	$146.0	$1.2	$3.0	$201.6
Output	$264.6	$601.9	$3.2	$19.6	$943.5

Source: BBC 2012; IMPLAN 2015.

Table C-14 Total Employment and Revenue Impacts Generated from Natural Gas Development and Operation (2017-26) - Alternative 5 ($ Millions)

Impact Type	County				Four County Region
	Garfield	Mesa	Pitkin	Rio Blanco	
Employment (Job-years)					
Direct	-29.0	-118.0	0	0	-150.0
Indirect	-4.7	-17.7	0	0	-24.6
Induced	-12.2	-76.6	0	0	-83.4
Total (2017-26)	-45.8	-212.2	0	0	-258.0
Income (Millions $)					
Labor Income	-$3.9	-$16.7	$0.0	$0.0	-$21.1
Value Added	-$2.3	-$9.9	$0.0	$0.0	-$12.1
Output	-$10.8	-$43.1	$0.0	$0.0	-$53.6

[1] No new well construction would occur. All 75 existing wells would be abandoned despite an average of 10 years of remaining production potential. Values shown are only for the 2017-26 loss in natural gas production for these existing wells.

Source: IMPLAN 2015; BBC 2012.

Government Revenue Payments from Natural Gas Production

Future county revenues were projected based on WRNF's increased future natural gas production. The additional county revenues are expected to support government programs and capital improvement projects. The revenue payments will likely not only directly maintain county agency staff but also will potentially generate new jobs. Based on the Garfield County's 2012 Financial Report, the IMPLAN analysis conservatively assumed that 50 percent of the revenue would be retained as "Reserve Funds." The remainder was assumed would be used for capital projects or services: road construction (7.5 percent); public building maintenance and repair (12.5 percent); other local government services (e.g., community development, airports and water) (15 percent); and county or program staff salaries (15 percent).

Tables C-15 to **C-17** shows the expected economic impacts from the projected future county revenues under the Alternatives 1, 4, and 5.

Table C-15 Total County Government Revenue Impacts (2017-36) - Alternative 1 ($ Millions)

Impact Type	County				Four County Region
	Garfield	Mesa	Pitkin	Rio Blanco	
Employment (Job-years)					
Direct	63.7	257.0	8.6	3.8	332.3
Indirect	16.2	88.0	2.4	0.3	121.6
Induced	18.7	125.9	2.0	0.5	146.2
Total (2017-36)	98.6	470.9	13.0	4.6	600.1
Income (Millions $)					
Labor Income	$4.4	$27.4	$1.1	$0.3	$36.9
Value Added	$5.0	$37.4	$1.3	$0.4	$49.6
Output	$9.2	$68.8	$2.3	$0.6	$89.8

Source: BBC 2012; IMPLAN 2015.

Table C-16 Total County Government Revenue Impacts (2017-36) - Alternative 4 ($ Millions)

Impact Type	County				Four County Region
	Garfield	Mesa	Pitkin	Rio Blanco	
Employment (Job-years)					
Direct	62.4	251.6	0.5	3.8	314.9
Indirect	15.8	86.1	0.2	0.3	115.2
Induced	18.3	123.3	0.1	0.4	138.6
Total (2017-36)	96.6	461.0	0.8	4.6	568.7
Income (Millions $)					
Labor Income	$4.3	$26.8	$0.1	$0.3	$34.9
Value Added	$4.8	$36.6	$0.1	$0.4	$47.0
Output	$9.0	$67.3	$0.1	$0.6	$85.1

Source: BBC 2012; IMPLAN 2015.

Table C-17 Total County Government Revenue Impacts (2017-26) - Alternative 5 ($ Millions)

Impact Type	County				Four County Region
	Garfield	Mesa	Pitkin	Rio Blanco	
Employment (Job-years)					
Direct	-5.3	-36.7	0	0	-41.7
Indirect	-1.3	-12.6	0	0	-15.3
Induced	-1.5	-18.0	0	0	-18.4
Total (2017-26)	-8.1	-67.3	0	0	-75.3
Income (Millions $)					
Labor Income	-$0.5	-$3.9	$0.0	$0.0	-$4.6
Value Added	-$0.7	-$5.3	$0.0	$0.0	-$6.2
Output	-$1.2	-$9.8	$0.0	$0.0	-$11.3

[1] No new well construction; 75 wells abandoned with an average of 10 years of remaining production potential. Values shown are only for the 2017-27 loss in natural gas production by existing wells.

Source: BBC 2012; IMPLAN 2015.

Appendix D

Methodology for Scaling RFDS for EIS Alternatives

This page intentionally left blank

Introduction

In preparing this EIS, BLM has used the Reasonably Foreseeable Development Scenario (RFDS) developed for the White River National Forest (WRNF) as the basis for analyzing the potential future indirect effects of each of the alternatives. The WRNF RFDS (USFS 2010) was prepared by the Forest Service, published in September, 2010, and was included as Appendix F in the WRNF Oil and Gas Leasing Draft EIS (USFS 2012).The RFDS is a long-term projection of the likely future oil and gas development and production within the WRNF over a defined period of time (20 years).

Based on the smaller and more specific area under consideration in this EIS than in the WRNF Oil and Gas Leasing Final EIS (USFS 2014a), BLM has further refined the RFDS using reasonable assumptions based on patterns of observed development.

An RFDS is a long-term projection (scenario) of oil and gas exploration, development, production and reclamation activity for a defined area and defined period of time. An RFDS is not a prediction of activity; rather it is a possible reasonable scenario of activity under a specified set of assumptions in order to evaluate potential effects that might reasonably occur as a result of BLM leasing. The RFDS is based on geology; resource occurrence potential; past and current leasing, exploration, and development activity; and engineering technology. It also considers economics and physical limitations on access to resources. An RFDS is not a decision, and it does not establish or imply a cap on development.

General Concept for Approach to Scaling the RFDS

The approach to scale the RFDS builds on the previously-prepared RFDS for the USFS (2012). The intent is to:

- Use existing data to enhance efficiency in preparing the BLM EIS;
- Prevent conflicting estimates of future development and reduce the potential for confusion;
- Coordinate efforts and analysis; and
- Facilitate incorporation of the USFS analysis by reference.

While incorporating existing RFDS, this approach refines it to provide a more specific projection for the 65 leases in question, basing the refined projection on reasonable assumptions and patterns of observed development.

The basic assumptions used to scale the RFDS are listed below. These assumptions are r used to analyze the impacts from future development in this EIS.

1. One well can be reasonably foreseen per undeveloped lease (including committed leases without on-lease development). This is assumed based on past bids to secure leases at auction and as a conservative starting point for effects analysis.
2. Additional foreseeable development will follow past development trends. Development trends can be grouped spatially based on the location of past development, production infrastructure, and access for exploration and production.
3. The total RFDS for the 65 existing (post-1993) leases is 444 wells. This assumption is based on:
    a. The RFDS for Alternative B: No New Leasing in the WRNF Final EIS (USFS 2014a) in which 423 wells are projected. This included the foreseeable development for all existing leases in the BLM Colorado River Valley Field Office (CRVFO), less the areas of No Surface Occupancy (NSO) stipulations. It assumes 10 wells in the BLM White River Field Office (WRFO).

   b. The USFS approach was modified slightly to use the USFS assumption of 202 acres per well, but discards the USFS programmatic assumption of not allocating wells for NSO lands. The rationale for modifying this approach is that, at the lease-specific level, it is clear that some development could access NSO areas from non-NSO parts of leases or from adjacent fee or BLM land. Therefore, the future projection for an initial EIS assessment area estimate of 87,638 acres for 64 leases was 434 wells. The future projection for the single Meeker area lease was 10 wells per the RFDS.

4. Based on the USFS RFDS, approximately 3.9 percent of the wells on all leases will be horizontally drilled (28 out of 722 in the RFDS for all leased areas).

Zones Used to Allocate the RFDS

The four zones described in Chapter 1.0, Section 1.2.1 of this EIS, were identified to group the leases geographically and by similar development potential based on past development activity. Using zones as the unit of comparison of impacts across the alternatives analyzed in detail facilitates discussions of potential impacts in a larger area than each lease; specific future locations of well, road, and pipeline development are unknown at the leasing stage of permitting. **Figure D-1** displays the location of the zones.

Zone 1

The leases in this zone could be accessed from existing or newly constructed well pads from adjacent private or BLM property using directional and horizontal drilling methods. This area is trending toward development of the Niobrara Formation in addition to the Mesa Verde Formation so it is anticipated that horizontal methods will be a more common method of developing these leases than in other zones. Existing infrastructure in Zone 1 includes pipelines and roads accessing the existing pads and wells within the Orchard Unit and the Place Mesa Unit. The following leases considered in this EIS are in Zone 1.

- COC 058677
- COC 059630
- COC 066727
- COC 066728
- COC 066729
- COC 066730
- COC 066731
- COC 066732
- COC 066733
- COC 066926

Y:\GIS\Projects\BLM_WhiteRiver_OG_EIS_60332451\FIGS\DOC1_PDEIS\FIG_ES-1_Leases_Vicinity.mxd

Date: 9/17/2015

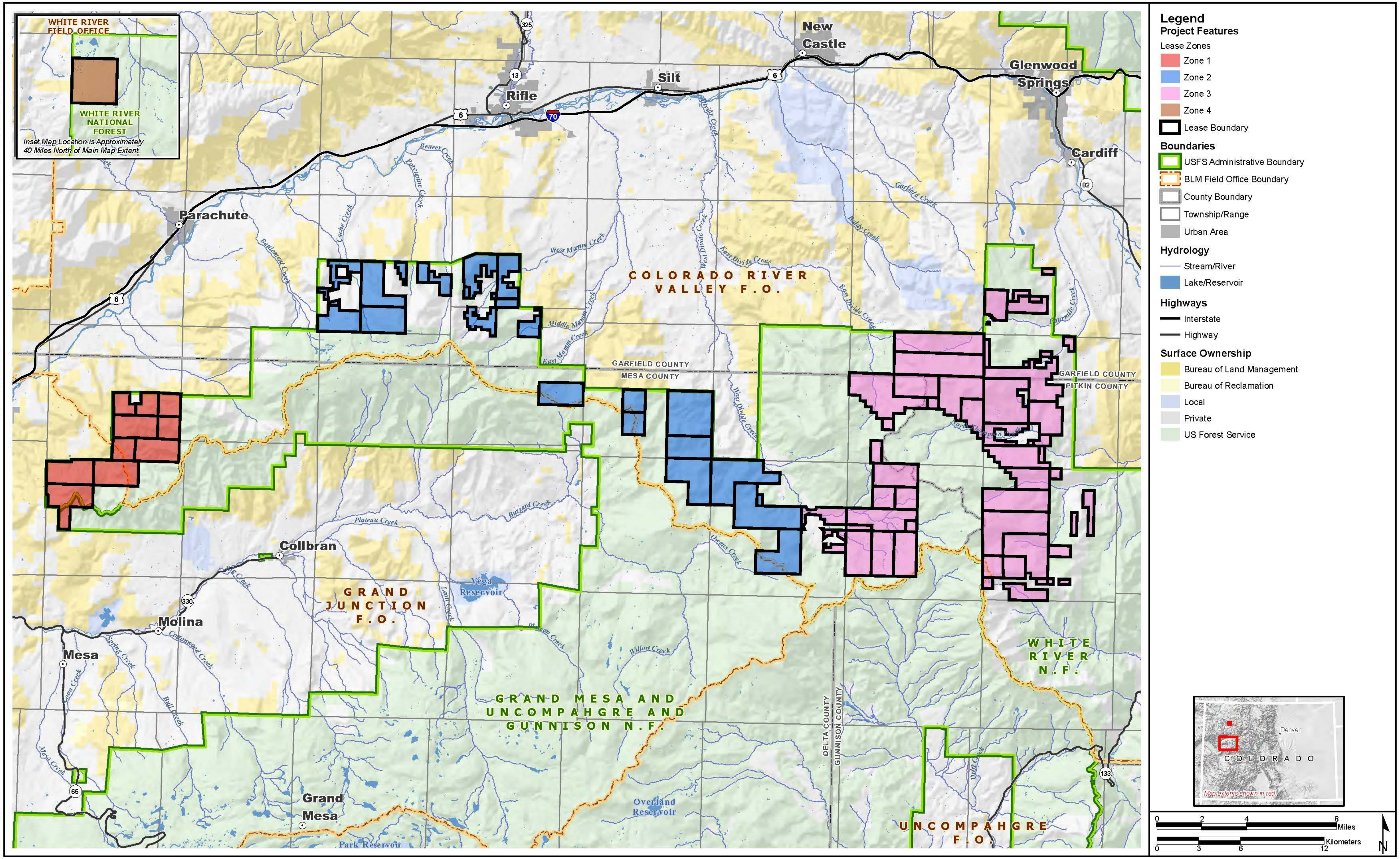


Figure D-1 General Location of Zones and Leases

This page intentionally left blank

Zone 2

The leases in this zone could be accessed from existing and newly constructed well pads. This area has primarily seen successful Mesa Verde Formation wells, but has had one successful horizontal Niobrara Formation well. It is anticipated that future development could include both Mesa Verde Formation wells and Niobrara Formation wells in those areas that can be accessed by both directional and horizontal drilling methods. Existing infrastructure in the zone includes numerous pipelines and roads accessing the existing wells. The following leases considered in this EIS are in Zone 2.

- COC 061121
- COC 066723
- COC 066724
- COC 066915
- COC 066916
- COC 066917
- COC 066918
- COC 066920
- COC 067147
- COC 067150
- COC 067542
- COC 067543
- COC 067544
- COC 070013
- COC 070014
- COC 070015
- COC 070016
- COC 070361
- COC 072157
- COC 075070
- COC 076123

Zone 3

The leases in this zone could be accessed primarily from newly constructed well pads. This area is anticipated to initially have a minimal number of exploration wells until the potential of the area has been proven. As a result, the number of wells that could be anticipated is lower than other zones. Existing infrastructure in the zone includes existing Forest Service roads and existing pipeline rights-of-way. Road improvements and pipeline installation would be required for the area to be developed. The following leases considered in this EIS are in Zone 3.

- COC 058835
- COC 058836
- COC 058837

- COC 058838
- COC 058839
- COC 058840
- COC 058841
- COC 066687
- COC 066688
- COC 066689
- COC 066690
- COC 066691
- COC 066692
- COC 066693
- COC 066694
- COC 066695
- COC 066696
- COC 066697
- COC 066698
- COC 066699
- COC 066700
- COC 066701
- COC 066702
- COC 066706
- COC 066707
- COC 066708
- COC 066709
- COC 066710
- COC 066711
- COC 066712
- COC 066908
- COC 066909
- COC 066913

Zone 4

The leases in Zone 4 could be accessed primarily from newly constructed well pads. Existing infrastructure in the zone is limited. However, there is an existing pipeline within approximately 1 mile of the lease. The location would be accessed from an existing county road next to the lease. The only lease considered in this EIS within Zone 4 is COC 066948.

RFDS Allocation by Zones

The basic assumptions used to allocate the total unconstrained RFDS by zone are summarized below.

1. Using the RFDS (USFS 2010) as a guide, unconstrained development is projected to be approximately one well for every 202 acres of a lease as a starting point.
2. There will be at least one well for each of the 65 leases without considering constraints from lease stipulations that may limit access to a lease.
3. Future development will follow past development trends and technology.
4. Almost 4 percent of all wells will be horizontally drilled but the distribution of horizontal wells is assumed to be based on past development techniques.

The process to estimate the number of wells per lease is summarized as follows.

1. Assign each lease within the BLM CRVFO an initial 1 well for a total of 64 wells.
2. Allocate the remaining reasonably foreseeable wells among each of the zones within the CRVFO (Zones 1, 2, and 3) according to past development trends. Past trends were assessed by identifying all wells drilled for oil and gas exploration and production within two adjacent sections of the zones, including dry holes, abandoned wells, plugged wells, and producing wells.
3. Per the WRNF EIS RFDS (USFS 2010), assume 10 wells for Zone 4 in the BLM WRFO.
4. Prorate zone totals to individual leases in proportion to lease acreage.

It is important to note that the application of these assumptions to each lease are only intended to be applied at the scale of the zone and do not reflect any knowledge or prediction of site-specific proposals for development at the scale of each lease. **Table D-1** summarizes the past trends and RFDS predictions by zone.

Table D-1 Existing Wells and Future Development by Zone

Current or Future	Well type	Zone 1	Zone 2	Zone 3	Zone 4	Total
Existing wells within 2 miles of lease boundaries	Horizontal	19	1	0	NA	**20**
	Directional	68	649	3	NA	**720**
	Vertical	44	83	47	NA	**174**
	Total	**131**	**733**	**50**	**NA**	**914**
Existing well distribution	Percentage of total wells	14.3%	80.2%	5.5%	NA	**100%**
	Percentage of horizontal wells	95.0%	5.0%	0.0%	NA	**100%**
Future Projection (Unconstrained)	All wells	63	318	53	10	**444**
	Horizontal wells	16	1	0 [1]	0	**17**

[1] For analysis purposes, it was assumed that 1 horizontal well would be drilled in Zone 3 although none have yet been drilled in this area to date.

Assumptions for Scaling the RFDS Projections by EIS Alternative

The basic assumptions used to develop the estimated future oil and gas development constrained by the stipulations under each EIS alternative within the 65 leases are summarized below.

1. Most wells will be directional or S-curve wells, rather than vertical wells. If a target formation cannot be reached using an S-curve wellbore, it is not likely to be developed.
2. The projections considered only apply to federal minerals. Unit boundaries and limitations were not considered.
3. The reach of directional wellbores depends on the type and depth of the target formation. While the maximum reach for directional wellbores is approximately 6,000 feet in this area, the historic data for the leases under consideration shows a range of directional reach between 500 and 6,000 feet, with a median of 2,000 feet.
4. Horizontal wells can reach target formations up to 10,500 feet away from the surface location of a well. More development may be possible if a higher proportion of horizontal wells is developed in the future.
5. Due to the relatively low projected future well numbers (as compared to full field development), well spacing and density were not considered limiting factors.
6. All NSO stipulations were considered when evaluating whether surface occupancy would be allowed on a lease. NSO stipulations were evaluated programmatically, so no consideration was given to the resource being protected by a specific NSO stipulation or whether that resource actually exists on the ground.
7. The number of well pads was calculated based on an assumed average of 7 wells per pad.
8. It is possible, or even likely, that off-lease development and associated surface disturbance could occur to access federal minerals in a lease if NSO stipulations make the lease surface unavailable.
9. In Zone 3 under Alternatives 1, 2, and 3, there are existing leases that are not closed to leasing surrounded by areas that are closed to leasing by the Forest Service. It was assumed that no off-lease surface locations would be allowed in areas that are identified as closed to leasing.
10. In all areas outside the existing 65 leases under consideration, future NSO stipulations and closed to leasing designations are based on the WRNF Oil and Gas Leasing Draft Record of Decision (USFS 2014b).
11. Where off-lease locations within the maximum directional reach extend beyond the Forest Service lands, NSO stipulations assigned by the BLM were considered on public lands. There are no NSO stipulations on fee lands without federal minerals.

Process of Scaling the RFDS Projections by EIS Alternative

GIS Analysis

A spatial analysis was performed using the geographic information system (GIS) for each alternative to assess the assumed reachable areas within each lease. Assumed areas of potential future development were identified using a combination of the assumed lateral wellbore reaches for each lease and exclusionary zones made up of NSO stipulations and lands closed to leasing, where applicable under each of the four alternatives. The specific reach of directional wellbores (see assumption 3 above) represents the distance around and within the lease that could be used to locate future wells. No potential future development was assumed within areas of NSO or within lands closed to leasing.

Scripting using the ArcPy Python libraries in Python 2.7.5 in ArcGIS was employed to identify and map the areas within and surrounding the existing 65 leases where there could be future development. The following general process steps for generating the areas of potential future development were completed for Alternatives 1, 2, 3, and 4 using the stipulations applicable to each alternative.

1. Compile exclusionary zones based on lands closed to leasing and the areas of NSO for lands within and adjacent to the leases.
2. For each lease, identify areas within the assumed directional reach for that lease.
3. Remove exclusionary zones (NSO and closed to leasing) from each lease's directional reach area.
4. Merge all of the directional reach areas within a lease to produce the area of potential future development for the alternative.
5. Create maps of each lease under each alternative to show the areas where surface occupation was assumed to be allowed for the purposes of analysis.

Figure D-2 displays a comparison of the resulting maps under Alternative 1 and Alternative 4 for Lease Number COC 066708 in Zone 3. This figure is provided as an example of how the GIS analysis was applied but is only intended to be applied at the scale of the zone for analysis of impacts in the EIS. It does not reflect any knowledge or prediction of site-specific proposals for development at the scale of each lease.

The maximum reach for the target formations that can be accessed in Lease Number COC 066708 was assumed to be 4,000 feet. The tan area displayed on the maps indicates the extent of the maximum directional reach either within the lease or off-lease. Note that where the hatched areas overlap, there are NSO stipulations delineated to protect more than one resource.

In **Figure D-2** under Alternative 1, no NSO stipulations have been designated in Lease COC 066708 so it is assumed for analysis that wells could be developed anywhere within the lease boundaries as well as off-lease. The only locations where it is assumed well pads could not be constructed are those areas off-lease within the tan shaded area with the hatching that indicates NSO stipulations.

In **Figure D-2** under Alternative 4, much of the lease has NSO stipulations and to the east, there are lands closed to leasing. The closed to leasing designation covers a small portion of Lease Number COC 066708, so this lease would be contracted (or cancelled) should Alternative 4 be selected for implementation. There remains some areas on-lease and off-lease within the tan area denoting the assumed maximum directional reach where it is assumed for analysis that well pads could be constructed to the access leased minerals.

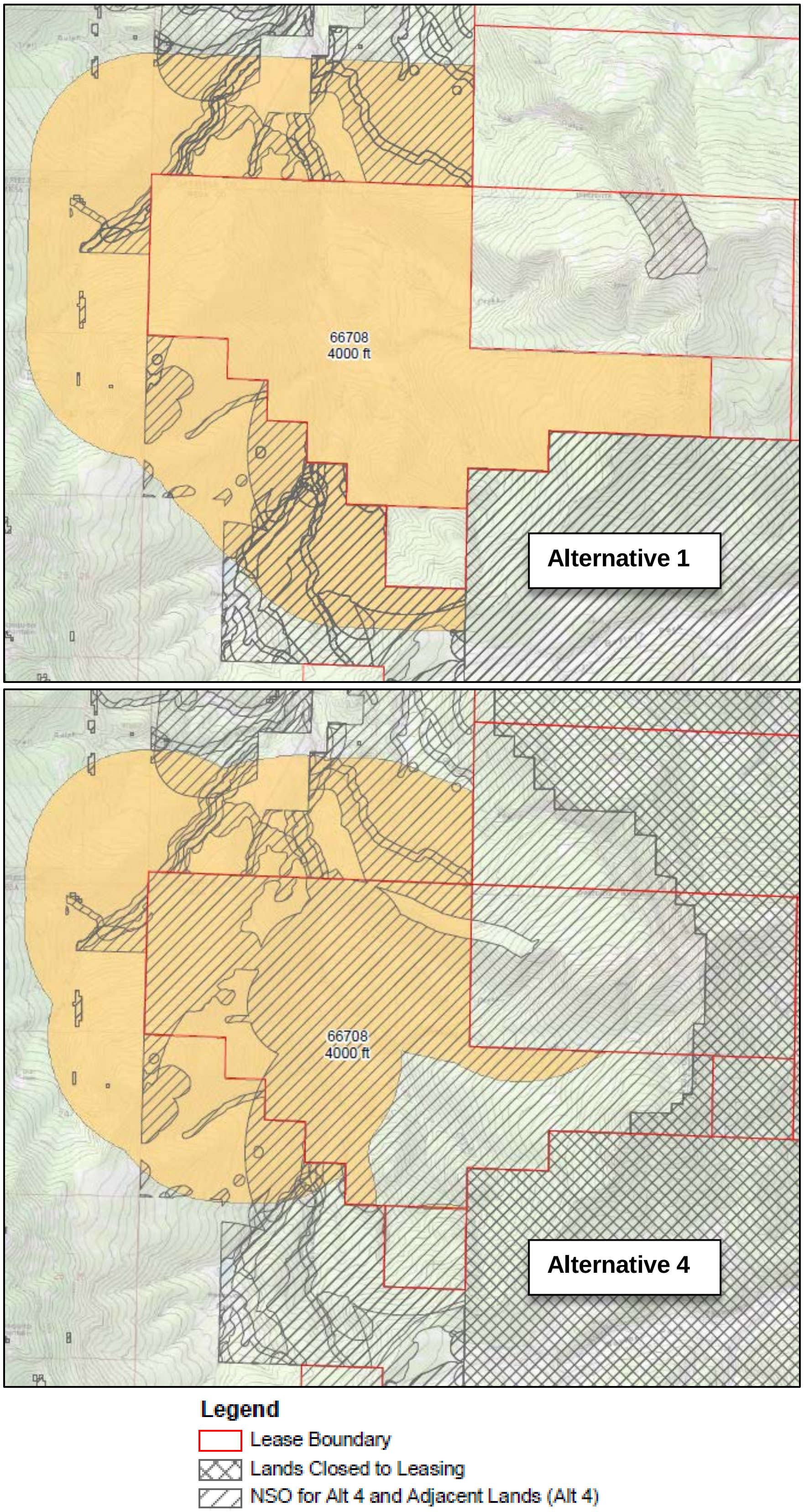


Figure D-2 **Comparison of Potential Development Areas in Lease COC 066708 under Alternatives 1 and 4**

Per Alternative Estimation of Well and Well Pad Numbers by Zone

Once the GIS analyses were completed and maps were generated, it was necessary to determine whether each individual lease could be developed under each alternative and to assign the projected number of wells that could be developed after the constraints resulting from NSO stipulations were applied. The BLM minerals staff estimated the number of wells that may be developed without consideration of lease stipulations or other constraints within each lease by distributing the number of wells shown for each zone in **Table D-1** across the leases in that zone, utilizing the RFDS assumptions stated in the previous section titled "General Concept for Approach to Scaling the RFDS."

Using the maximum projected well numbers as a starting point, each lease map (such as the example shown in **Figure D-2**) was reviewed under each alternative to determine whether the unconstrained number of wells could be developed or whether the number would be reduced due to on-lease and off-lease NSO stipulations making portions of the lease inaccessible. Essentially, the maps were used to answer the following two questions:

- Is there land available within the lease to construct a well pad and develop a well?
- If NSO stipulations cover the entire lease, is there land available off-lease that could be reached using directional drilling up to the maximum reach assumed?

In some situations, where an entire lease would be covered by NSO stipulations under an alternative, it was assumed that a well could be developed off-lease where there is land without NSO constraints within the maximum directional reach assumed for that lease. No consideration was given to land ownership so it is possible that off-lease development could occur on fee land or land managed by the Forest Service or the BLM.

Horizontal wells were allocated per zone, were not assumed to change per alternative based on the reach analysis, and could occur anywhere in the zone. Well numbers and well pad numbers were aggregated for each zone, providing the information in **Table D-2** that was used for analysis of impacts.

Table D-2 Number of Projected Wells by Alternative

Zone/Well Type	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Zone 1				
Vertical/Directional Wells	19.7	19.7	19.7	19.7
Horizontal wells	16	16	16	16
Pads	5.1	5.1	5.1	5.1
Zone 2				
Vertical/Directional Wells	318.1	318.1	318.1	318.1
Horizontal wells	1	1	1	1
Pads	45.6	45.6	45.6	45.6
Zone 3				
Vertical/Directional Wells	50.7	50.7	47.6	17.9
Horizontal wells	1	1	1	0.4
Pads	7.4	7.4	6.9	2.6

Table D-2 Number of Projected Wells by Alternative

Zone/Well Type	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Zone 4				
Vertical/Directional Wells	10	10	10	10
Horizontal wells	0	0	0	0
Pads	1.4	1.4	1.4	1.4
Vertical/Directional Wells	398.4	398.4	395.4	365.7
Horizontal wells	18	18	18	17.4
Pads	59.5	59.5	59.1	54.7

Note: Under Alternative 5 all leases would be cancelled so no well numbers have been included for this alternative.

One final evaluation was performed to identify whether there are any leases that would not be accessible for development using horizontal drilling. To do this, a map was prepared to show the locations of NSO stipulations and areas closed to leasing within the maximum reach of a horizontal wellbore (10,500 feet), which is approximately 2 miles. **Figure D-3** displays NSO stipulations within 2 miles outside of the boundaries of the 65 previously issued leases and areas closed to leasing that are reflected in the decision presented in the WRNF Draft ROD (USFS 2014b). Based on this map, it was determined that all leases could be developed horizontally so all leases could be developed should more extensive use of horizontal drilling be employed by operators, except where leases would be cancelled under Alternative 4 (shown in pink and identified as Closed to Leasing in the legend of **Figure D-3**).

Once the numbers of wells and well pads were estimated for each zone, the acres of surface disturbance per pad, miles of roads and pipelines, water usage for drilling and completion, and production of gas and produced water was estimated (see Table 2-8 in Section 2.7.5) using average information derived from the RFDS (USFS 2010) and assumptions presented in the WRNF Oil and Gas Leasing Final EIS (USFS 2014a).

This information formed the basis of the analysis of impacts from predicted future oil and gas development under Alternatives 1, 2, 3, and 4 in this EIS.

Reference

U.S. Forest Service (USFS). 2014a. White River National Forest Oil and Gas Leasing Final Environmental Impact Statement. Eagle, Garfield, Gunnison, Mesa, Moffat, Pitkin, Rio Blanco, Routt, and Summit Counties, Colorado. U.S. Department of Agriculture, White River National Forest, December.

U.S. Forest Service (USFS). 2014b. Draft Record of Decision. Oil and Gas Leasing on Lands Administered by the White River National Forest. Eagle, Garfield, Gunnison, Mesa, Moffat, Pitkin, Rio Blanco, Routt, and Summit Counties, Colorado December 9.

U.S. Forest Service (USFS). 2010. Reasonably Foreseeable Development Scenario for Oil and Gas Activities on the White River National Forest. White River National Forest. September.

Y:\GIS\Projects\BLM_WhiteRiver_OG_EIS_60332451\FIGs\DOC1_PDEIS\FigXXX_AdjacentNSO.mxd

Date: 9/21/2015

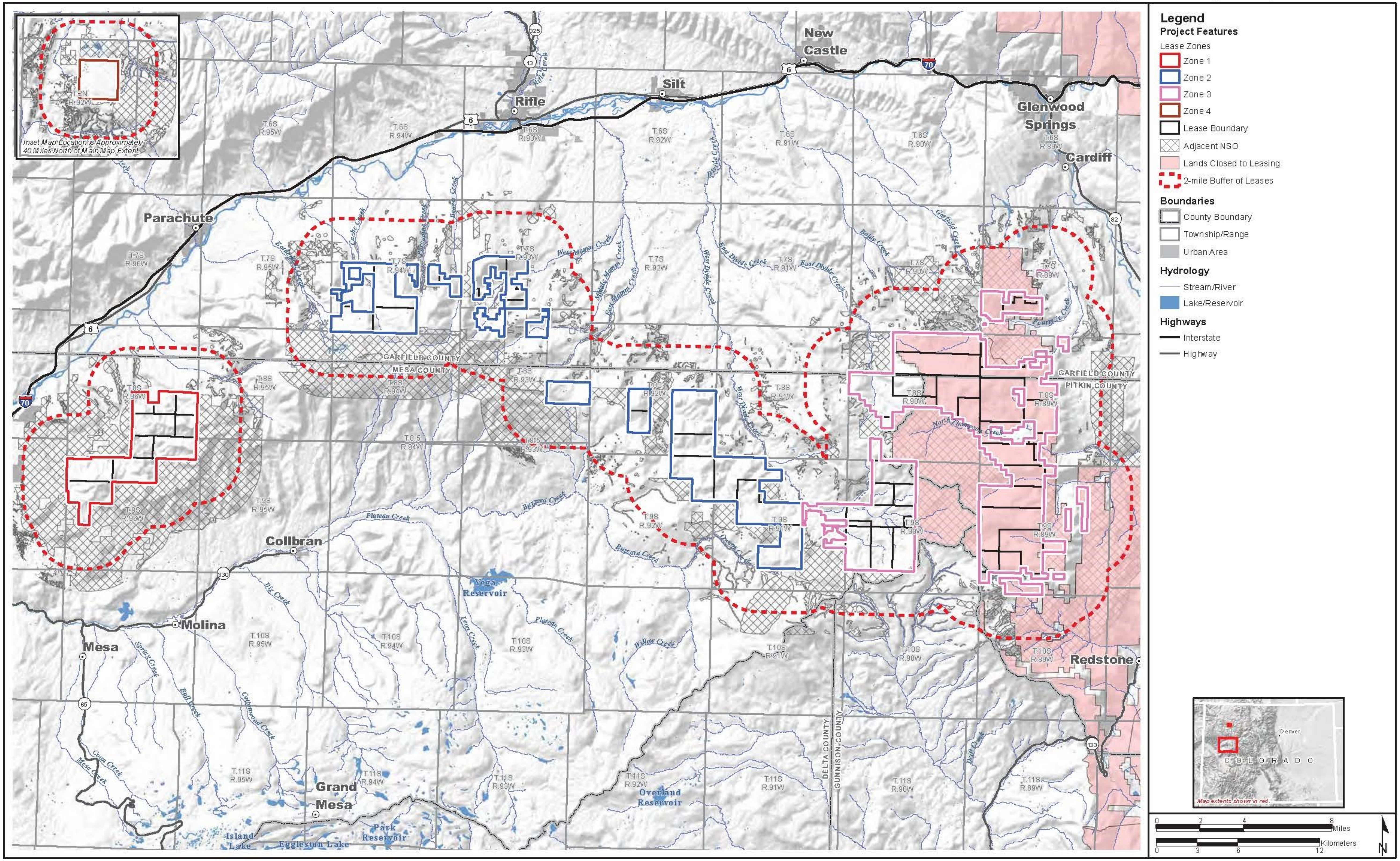


Figure D-3 NSO Stipulations within 2 Miles of Lease Boundaries

This page intentionally left blank